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Just When Did He Cross the Tape?

Eliminating the personal equation in the judges' stand

By Latimer J. Wilson

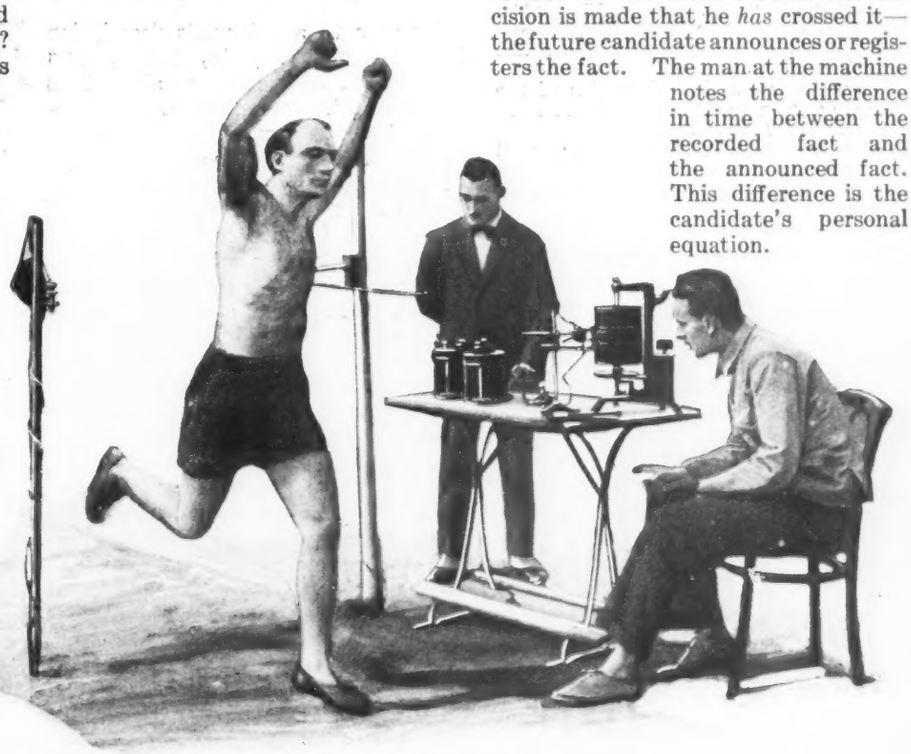
FLAMSTEED, director of Greenwich Observatory, England, two centuries ago, had an assistant. He would watch a star approach the "spider-web" line in the field of view, and as it crossed the line he recorded the time. But investigation showed that he was persistently one second out in his announcement of transits. Flamsteed discharged him.

Such delicate observations as transits can be reliable only when the "personal equation" is allowed for in the deduction of results. Nowadays these observations are taken, and the "mean" taken to eliminate the "personal equation." Every one has a "personal equation," which, in plain words, means his margin of error in judging quickly presented facts.

What happens when a ray of light falls upon the retina, or when a sound falls upon the organs of the ear? The stimulus of the sight or sound is immediately conveyed to the brain through the nerve-fibers, and the rate of this motion is from 390 to 780 feet a second. When these impressions are sent to the brain, their effect is transferred into action in the case of the man who must announce the happening of an event. Here again the nerve force must travel a certain space in a certain time. This is the "personal equation" as far as the eye is concerned. From sense-organ to brain, from brain to the motor, is the flow of the neurian energy.

That the time required for these reactions differs in different persons, there can be no doubt. Take a watch and call out the instant the second-hand reaches a certain point of the dial. Let others try this with you, and no two will call out the time at precisely the same instant. There will be always some slight variation. But quick judgment accurately given is of utmost importance in the selection of judges who must decide the winners in a race. To select a judge, compare him with a mechanical device that registers the exact moment a runner in a race crosses the line.

Not only must the judge decide when the runner crosses the line, but he must act, either by noting the time in calling out the fact, the very moment he decides that the runner has crossed the line. Here then is a quality of judgment that can be tested by comparing the performance of the individual with the work of the machine. The experienced judge who compares the man with the machine sits where he can watch the recording device of the instrument. He notes the time. The man to be tested stands where he has a good view of the line across which the winner must dash. As the runner crosses it—the exact instant the decision is made that he *has* crossed it—the future candidate announces or registers the fact. The man at the machine notes the difference in time between the recorded fact and the announced fact. This difference is the candidate's personal equation.



As the runner crosses the line, he snaps a thread and closes an electrical circuit. The exact moment is recorded upon a clock-driven drum. The device tests the accuracy of the judge, who registers his decision the instant he observes the runner cross the line

Shall I Invest in Oil?

Yes—if you follow such precautions as are here outlined

By Guy Elliott Mitchell
of the United States Geological Survey

THE man or woman who has not had the following statement thrust upon him in the past two or three years must indeed be a hermit:

Last Chance—Six Cents a Share

A producing oil-well is ten times as valuable as a gold-mine. It makes dollars ten times as fast. Oil investments are the greatest money-makers of any class of investments.

The Get-a-Million-in-a-Week Oil and Refining Company, in addition to its other enormous producing properties, has just acquired a 1200-acre lease in the richest portion of the Greatestever Oil Field and will immediately begin drilling in this proved territory.

For a *few days* a limited portion of the Company's reserve stock will be offered at SIX CENTS A SHARE.

We want you to have at least a small block of this choice stock at the present low price. Telegraph your order and we will reserve the stock.

Full-page oil "ads" in the newspapers, and oil circulars distributed by the billion, have added materially to the present shortage of paper in the United States.

If you are thinking of investing in an advertised oil-stock company, don't do it. The chances are all against you. Real oil-drilling investments are not offered to the public through the sale of stock at a few cents a share. The determining of probable oil territory is now a geologic science, and there is always plenty of money available to engage in legitimate drilling without advertising stock for sale at far below par. If, however, you are determined to buy oil stock, you may follow a course of procedure that will inform you whether the company to which you intrust your savings is a substantial one.

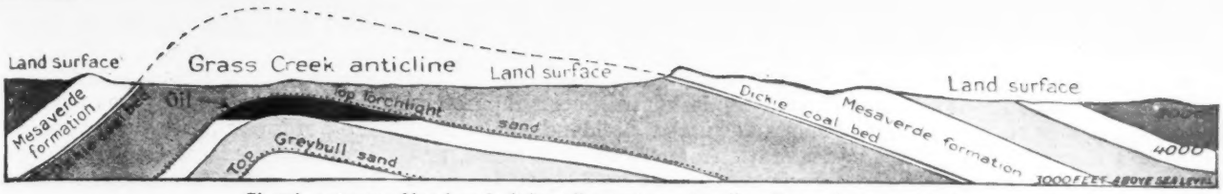
Forget at once the intimation, conveyed in virtually every oil-stock circular, that you must get in your subscription immediately, before the price of the stock goes up. Then sit down and write the company for an exact description of the land it has acquired and precisely where it proposes to drill.

What to Ask

Be sure to ask for this description by section, township, range, and county, and be as insistent about it as you would in demanding the description of a lot on which you are going to build a house. Ask also for a copy of the report by the company's geologist on this particular tract. If it is a legitimate company, it will probably have employed a geologist, for the simple reason that a geologist at a salary of even one hundred dollars a day can advise the company at a comparatively small cost where or where not to put down a well that is going to cost anywhere from $10,000 to $75,000 to drill. Ask the company further for a detailed statement of the professional training and the present professional connections of this geologist. If the company is on the square, it will answer these questions fully.

Having secured this information, your second step will be to refer the matter to the United States Geological Survey at Washington, D. C. This bureau has investigated and geologically surveyed virtually every oil-field in the United States. It can generally answer your inquiry as to the character of the land of which you send it a description, and as to whether your company is a producer.

The data you will thus gain will enable you to decide calmly—provided you stop reading the



Showing strata of land underlying oil country. An oil-well may be a gambler's chance one day and a million-dollar property the next

company's advertisements—whether you think the investment a good one.

It is well to emphasize the fact that few if any of the real oil companies are without the services of expert geologists, and that no such company will buy or lease oil territory without a full geological report on the land involved. The day of drilling by big companies on the advice of rough-and-ready and "experienced" oil-drillers and on "hunches," is long past. You probably cannot afford to hire a geologist, but you can get good geological advice from the government without cost. In this manner you can determine whether you are dealing with a concern organized to sell stock. It may be added that while every such concern will tell you in general terms that it courts the fullest inquiry and investigation, you probably will get little real information, because they are in business not to produce oil, but to sell stock.

The oil industry affords the dishonest promoter the greatest of all opportunities for playing his game.

A good oil strike far transcends the most lurid gold discovery. There are 215,000 producing oil-wells in the United States, and very many of them came in as big gushers. On one day such a well was merely a gambler's chance; overnight it may become a one-million-dollar property, producing without labor on the part of the owner one thousand or five thousand, perhaps ten thousand, dollars a day.

Oil-Promoting Psychology

One of these big gushers, stating the number of barrels produced a day, is mentioned in your advertisement as having come in in the same county where the new company has a 500-acre lease. You unconsciously imbibe the impression that you surely must have a fifty-fifty chance of a gusher too. But a county is a large unit and counties are not entirely underlain by oil. One Texas oil county, for instance, has 925 square miles; another county in the very midst of one of Oklahoma's big oil-fields has 2277 square miles. But oil-lease areas are always stated in acres, and 2277 square miles equals 1,457,000 acres. Your own chances might be worth while if you owned the proposed well, or a half or a quarter or an actual hundredth interest in it. But you are urged to buy 1000 shares of stock at a few cents a share in a million-dollar company.

That Mythical Million Dollars

Let us see what a million-dollar company really is.

It is advertised to be organized with $1,000,000 capital, $1 a share par value. But you and everybody else buy stock at, say, 8 cents a share. Even if all the stock is sold, the cash result is only $80,000 instead of $1,000,000; but out of this the oil-stock salesmen and brokers must get 50 per cent. This leaves $40,000. Then the promoters must be paid for the leases they have purchased, and a lease of any character whatever may easily cost $10,000. This leaves $30,000. Now, even honest promoters have some expenses and must live during the period of promotion and drilling, so that at the very least another $10,000 must be deducted. Thus we have an actual working capital, with all the stock sold, of $20,000 for this "strong $1,000,000 company," and you have an infinitesimal 1/12,500 interest. Now, remember also that the average cost of drilling one well will eat up this $20,000 and in most cases require another $10,000, or $20,000, or $30,000

Therefore it is a great deal easier for the promoters to spend about $5000 or less on a poor or worthless lease and on a derrick to make a showing, and let it go at that, saving $15,000 of yours and other investors' money for their own paramount needs. With this stake thay can go blithely along and promote another company.

It is the business of stock-promotion advertisers to build successes on paper and to explain away suggested possibilities of failure.

15 TO 100% ADVANCE
OIL STOCK
Big, Quick, Sure Profits
ONE MILLION GOLD DOLLARS
RISK ELIMINATED
INCREASED PRODUCTION OF OIL WILL WIN THE WAR
Results Will Be Quick!
Get Your Stock Now!
YOUR CHANCE—Mail Quick
Dividends for You
These 100% Profits
A New Sure Way to Play the Oil Game
WHERE OIL GUSHERS GROW!
OIL ENRICHES THOUSANDS
DIVIDENDS TO START AT 2% A MONTH
MILLIONS IN SIGHT FOR THE STATE OF OKLA.
Oil Is the Safest Investment in America Today.
Oil Is Wealth
Final Opportunity at 10c!

Typical of the advertisements of promoters are these circulars. It will take all your strength of mind not to rush in and buy before making the simple investigation that the writer of this article suggests

To read many of the oil-stock advertisements is to feel money trickling through your fingers. Of course we all know that there is no greater gamble on earth than oil, and that the failures far exceed the successes. But in reading through the advertising of a new oil-stock promotion, one experiences a creeping sensation that *this particular company* is destined to be a winner.

The writer once spent a few hours among the Fraud Order oil files of the Post-Office department. The proved lies told by these companies, the representations they made without any basis of facts, and the amounts of money they secured from the public as set forth in the records are enough to make devils weep.

A Man with a Past

A New York promoter, who is now under indictment, has promoted thirteen oil companies and flicked Heaven knows how

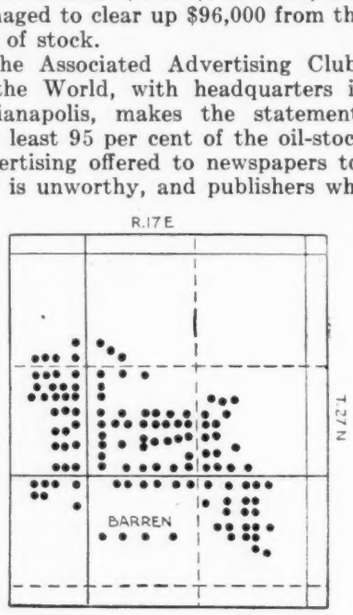
many "investors." All thirteen companies are rankly fraudulent. The last one was organized with 3,000,000 shares of stock without a single solitary asset. The joke was that the whole burden of the advertising in No. 13 was to convince the public that the company was very conservative. The promoter frowned down the methods of the get-rich-quick chance concerns, and told his customers that in this substantial company only 20 or 24 per cent profit a year was possible. It was an investment, in no sense a speculative venture. Incidentally he created a market for the stock by himself buying 1,000,000 shares at prices advancing from 30 to 70 cents a share—par value $1.

Another American-Mexican oil company with a capital of $20,000,000 advertised property in Mexico valued at $134,000,000. This concern was going to become in effect the Standard Oil Company of Mexico; it had one contract for the delivery of 100,000,000 barrels of oil over a period of several years, and another contract with a foreign government calling for the delivery of 100,000 barrels a month. Thousands of dollars' worth of stock was sold, mostly to poor people, but the Post-Office department found no assets and that all the money from stock sales had gone into the promoter's pockets.

Some Rich Oil Companies—on Paper

Another company—a "Guaranty Investment Company" wherein the verdict was "guilty"—advertised itself as being as good as any bank. It owned five subsidiary oil companies and a 2000-barrel-a-day refinery—on paper. It actually acquired one very shallow well with a capacity of less than one barrel of oil a day. Other than this it had no resources; but it issued thousands of photographic circulars, declared dividends, advanced its stock from $1 to $9 a share, and managed to clear up $96,000 from the sale of stock.

The Associated Advertising Clubs of the World, with headquarters in Indianapolis, makes the statement: "At least 95 per cent of the oil-stock advertising offered to newspapers today is unworthy, and publishers who want to be honest to their subscribers are refusing to give it space."



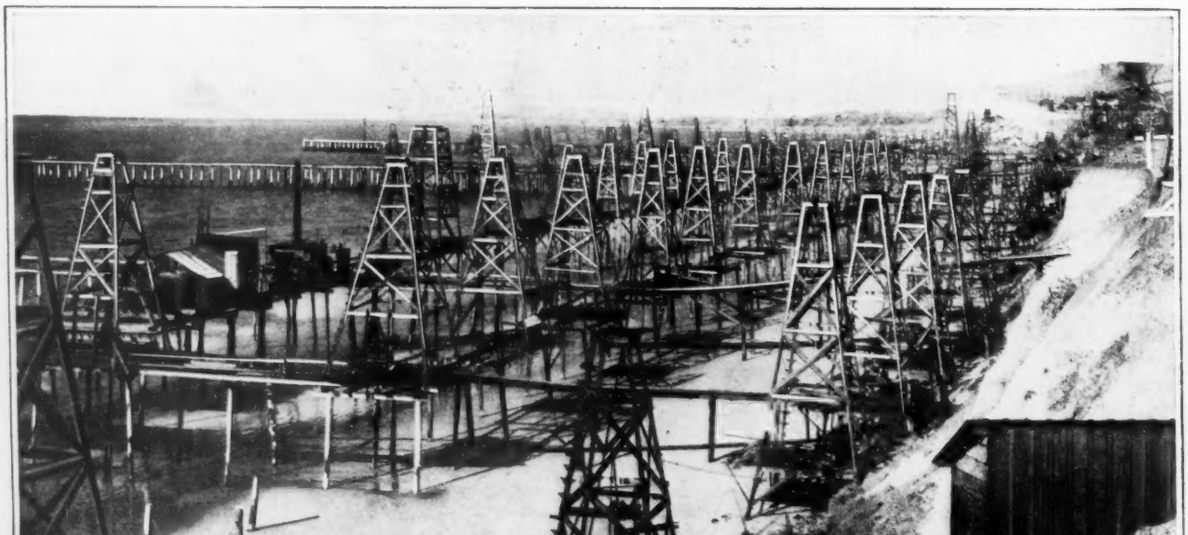
This barren spot in northern Oklahoma is surrounded by productive oil-fields. The promoter will try to sell stock in a company to develop this barren spot, arguing that oil must be found because of its very location

Probably the greatest rush of oil-stock selling is over. Billions of dollars have been milked from the small investor caught in the net of flamboyant and extravagant advertising; but in the past year or so the public has become more discriminating. The oil-stock promoters and advertisers have been quick to change their tone. Your present-day promoter usually invokes the science of geology and even quotes the words of a State Geological Survey or of the Federal Geological Survey, although such quotations have but a remote bearing upon the particular oil stock sought to be unloaded. Some of the shadiest oil literature quotes Director George Otis Smith, of the United States Geological Survey, in large type, and a hasty perusal of the statement leaves the reader under the impression that the company has the unqualified endorsement of the Geological Survey.

Beware of that Oily Candor!

An alluring form of advertising is a perfectly frank statement that the purchase of the oil stock in question is a speculation. If you can not afford to take a chance and lose $10 or $25, do not go into this scheme, because oil investments are uncertain. Admittedly it is stated, it is a long shot; however, the backers of the company have such a firm belief in it, based on the best geological information obtainable, that they have put their own money into the venture. Don't go into it if you can't afford to lose the $10, but if it wins, the returns will be fabulous. And at this critical, psychological juncture the advertisement tells of two or three strikes in "similar" fields where land worth originally a few dollars an acre became worth a million dollars overnight, so that instead of feeling that you cannot afford to lose your $10, you become anxious to know whether the company would take as much as $200 of your money.

One company, operating or rather



A picture of this sort in an oil-stock circular may indicate great activity and it may indicate nothing at all. A million-dollar company sounds big, but what would be your profit at eight cents a share?

selling stock, in the very shadow of the nation's Capitol, actually advertised that it would refuse to take more than $2000 of any person's money, because, this psychological advertiser stated, that was as much as any ordinary person could afford to lose on a gamble. And yet, after you finished absorbing the allure of this half-page advertisement, you felt that if you had the money you would know how to circumvent the high-minded officials of this company and buy another $2000 worth of stock in your wife's name, and still another $2000 worth in your stenographer's name, and then have it transferred to you.

How the stock promoters laugh when they see the public biting at any of these new baits!

The best conception that we may get of the value of oil stock advertised through the newspapers or by circular is from the fact that not a single share of such stock is ever bought by an oil geologist, either those in the United States Geological Survey, the state geological surveys, or those in private practice.

Never, Never Go Near an Oil-Field

There is just one other thing to emphasize. If you have been able to withstand the oil-stock circulars and newspaper advertisements, never let the personal oil-stock salesmen get near you. All he wants is a chance. Do not say that you are keen and shrewd and hard-headed and know what you are doing. He will get your money, I say. If you have a thousand dollars to invest, so that you decide it is worth while to make a trip to the oil property and examine it yourself, then you are, beyond the peradventure of a doubt, lost, lost, lost. You will become inoculated with the fever of the oil country and before your man lets you go—penniless—you will have become convinced that his company has the finest prospects and certainties of any of them.

There are a dozen tricks worked on the ground to one away from it. I will mention just one that is a winner. Almost every oil-field has barren spots—why, even geologists cannot say with certainty. You will be shown a 160-acre tract right in the very heart of the field, with oil-wells spouting or pumping on all sides. Even a tyro can see at a glance that the oil must be under the 160 acres which your company has acquired by the most peculiarly wonderful good fortune, and after you have handed over all your cash, you turn in your diamond pin and your wife's ring, if you can get hold of it. Some of these barren spots, where nothing but dusters—dry holes—result, are more productive of dollars than the best part of the oil-field.

You hear oil promoters also talk a great deal about domes. The oil is found under a dome or anticline of rock or tight clay. The shell of the dome is what keeps the oil from rising through the earth and dissipating. It has collected there during hundreds of centuries and is under high pressure, so that when the drill pierces the dome the oil rushes up to the surface. But the oil may be only in the very top of the dome, and while your company's land is located along the dome all right, it may be half a mile away from the oil. So that, unless the investor goes in company with a reputable geologist or operator, he had better keep away from an oil-field. Furthermore, what will be shown to you on the surface of the ground as an ideal dome may be no indication of the oil structure beneath the ground. Some apparent domes are not oil domes at all, and conversely some of the heaviest producing oil-fields are depressions or perfectly flat. The domes are concealed except to the geologist, who traces out their structures from miles away.

Follow These Precautions

If you are thinking of putting your money into oil, write the company or broker (1) for the exact description of the land; (2) for the exact description of the point selected for drilling; (3) for a copy of the report of geologist who examined its oil possibilities; (4) for the name and the credentials of that geologist.

Write to the director of the United States Geological Survey, Washington, D. C., inclosing the answers to these questions and asking advice.

Write a similar letter to the Director of the State Geological Survey of the state in which the company is operating.

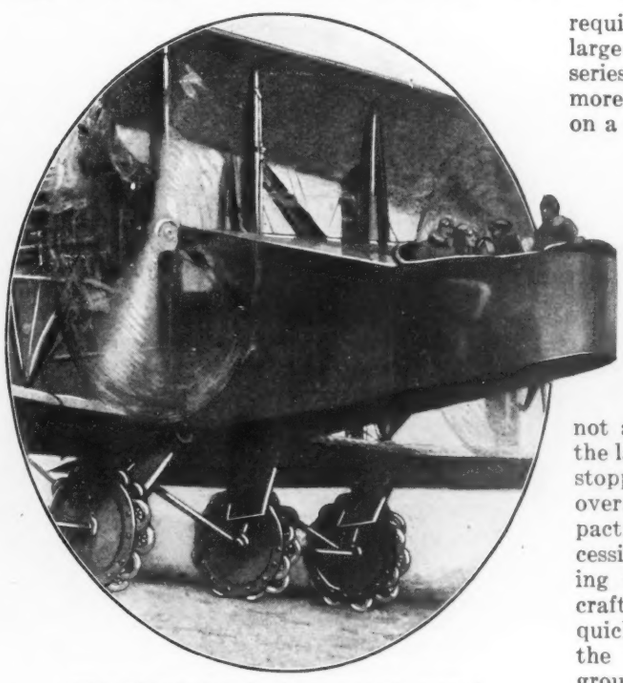
This will be a better procedure than handing over your cash, and, as so many do, later writing to the Geological Survey for this same information when it is too late to be of any use.

Landing on the Wheel within Wheels

WHY should large wheels instead of small ones be used on an airplane's landing-gear when rough ground is encountered? The action of small and large wheels is illustrated when a roller skate is compared with a bicycle. See what happens when each runs over a rough surface. The tiny wheels of the roller skate are all right on a smooth pavement, and so are the small wheels of an airplane. They make less speed than large wheels and come to a stop in less space.

But try to skate over the soft damp ground, and the little wheels will sink up to their hubs before they get a chance to roll. The bicycle goes with ease over ground which would stop the roller skate. The airplane wheels must combine the ability of the bicycle to travel over rough or wet ground, with the ability of the roller skate to stop within a reasonable space when landing on very smooth ground.

A recent invention meets these requirements. The idea of a large wheel is carried out in a series of small wheels, in one or more vertical planes, mounted on a rotating frame so that they form the periphery of what would otherwise be a wheel of several times their diameter.

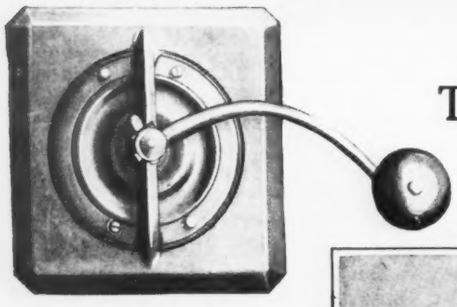


When the airplane lands on smooth ground, small wheels operate. When on rough ground, the small wheels rotate around the large one

The airplane, coming to the ground in a rough field, strikes the soil with one of the small wheels, which would stick and sink to its hub if the small wheels were not arranged around the rim of the large wheel, and the airplane, stopping suddenly, would "nose over." Instead, the force of impact brings into position in succession the small wheels, retarding the forward motion of the craft and helping to bring it to a quick but smooth stop. When the airplane lands on smooth ground, it will not run too fast or too far, as it would if only large wheels were used.

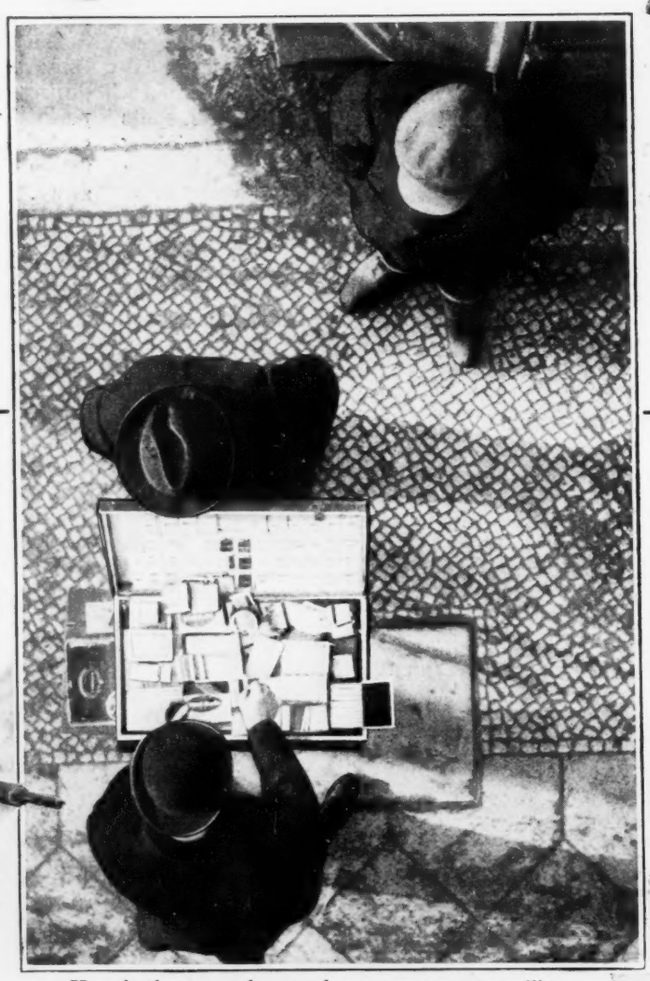
As the Bird Sees Us

The photographer takes some top views



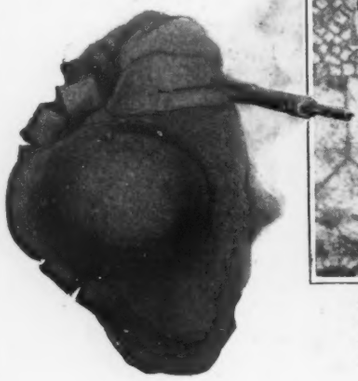
The bell-shaped instrument at the end of the projecting arm looks like an alarm of some sort. But it is a simple, old-fashioned coffee-grinder, and the bell-shaped instrument is a knob

This strange shape is a team of horses as they look from overhead. You may get this same effect by looking from a sky-scraper window

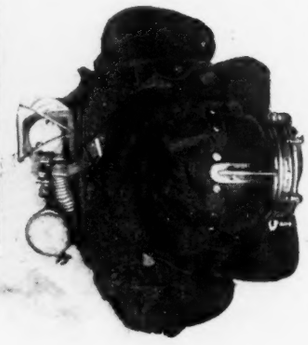


Here is the man who stands on street corners selling collar-buttons, stickpins, and cigarettes. His suitcase appears to be resting on the ground; in reality it is on a high metal stand

Never in all the four years of war did we see this view of a German soldier. But it is undoubtedly very familiar to the aviators who flew over the German trenches



Is this another view of the German soldier, wearing a gas-mask? Men in uniform look much alike from above. However, this happens to be a fireman wearing his oxygen helmet



What is this veiled mystery? A photographer preparing to take a picture. The cobblestones on which he stands are remarkably distinct, but you can't see much of him

Perhaps 'tis well that the bicycle rider was unaware of the fact that his top view was being photographed. He might have looked up, lost his balance, and spoiled the whole thing

Taking Out the Wrinkles Without a Scar

REMOVING wrinkles is a comparatively new development of painless surgery. A wrinkle is too much skin brought about on parts of the face by the expansion of the skin. This is caused by thinking, worrying, or even by laughing. Persons who do not think, worry, or laugh have tight skins and masklike expressions.

When these folds of skin over the subcutaneous tissue grow bulky and disagreeable, the wearer of the wrinkles looks into the mirror and thinks "How terrible! I'm growing old and wrinkled!" But here Dr. L. R. Stoddard, a New York surgeon, comes as the "beauty doctor" to smooth away the impressions of time.

Removing stitches with a safety razor. This is done about forty-eight hours after the operation. Note the absence of any scar below the eyes, whence the stitches have been removed

This shows two pieces of skin, greatly magnified, containing the wrinkles that have been removed from the face of a patient. Note their symmetrical form

The skin is drawn together tightly, smoothing out any other nearby wrinkles. Stitches are then taken across the cut edges of the skin. The length across from needle-hole to needle-hole is not greater than one thirty-second of an inch

Before starting, a two-per-cent solution of cocaine is injected under the skin to lift it, as a blister lifts the skin, from the subcutaneous tissue. With the skin thus puckered up, the incision is made and the wrinkle is carefully cut out

Here can be seen the stitches unremoved below the eye, while those above the eyelid have been removed and all trace of a scar eliminated. Immediately after stitching, aristol powder is applied as a dressing. Care is taken not to cut any of the larger branches of blood-vessels, so that no discoloration will result

For Thirteen Hours We Clung to the Balloon Rigging

How the pilots of a navy balloon cut away the basket to lessen the weight, and how one of them slept in the air, clinging to the cordage

By Lieutenant Raffe Emerson

U. S. Navy Reserve Flying Corps

THE National Balloon race of 1920 began at Birmingham, Alabama, on September 25. With winds usually to be expected, the city was sufficiently inland; and the by-product gas furnished by a local steel company was good, having a lift, as balloonists express it, of about forty-five or forty-eight pounds to a thousand cubic feet, corresponding to a minimum of thirty-six hundred pounds, and a maximum of about two tons for standard eighty-thousand-cubic-foot-capacity racing balloons.

The object of the race was to qualify two crews who would, with Ralph Upson, the holder of the international championship, compose a defending team of three balloons against the challenge of France, Belgium, and Italy, in the international contest to be run on October 23, also from Birmingham. In these races, the balloon making the farthest straight line, or rather great circle, distance from the starting-point is the winner. The circuitous course of the actual balloon track, due to variation in wind direction, is not credited.

In the national race were eleven starters. Besides Upson's, there were four balloons piloted by army men, one by navy men, and five by civilians.

The greatest distance was made by an old professional balloon-racer of international experience, H. E. Honeywell, about six hundred and eighty miles. He landed near Thamesville, Ontario, after passing over Toledo and the western tip of Lake Erie.

The Fate of an Army Balloon

An army balloon, piloted by Lieutenant Thompson, came down also in Ontario, nine miles from Honeywell's landing, and only 1.3 miles less in distance from Birmingham. Part of the equipment of this balloon dipped in the lake while crossing, and a watery finish was barely averted.

This is probably the only race in which Mr. Ralph Upson has been a contestant, that he did not win. Rather than take a chance at crossing Lake Erie, he landed near Amherst, Ohio, about six miles west of Elyria. Therefore he was third, his landing-point being six hundred and twenty miles from Birmingham.

About five miles less in distance from Birmingham, but some fifty-five miles to the westward, near the lake shore, landed the *Navy*, piloted by Lieutenant Sloman and the author.

One contestant landed in Ohio, near the Indiana line; another in southern Indiana, and all the rest in Kentucky, some three hundred miles from Birmingham. The first three composed the American team in the international event of 1920.

Balloon races start just before sunset. More than a hundred pounds of ballast is used to weigh into the night, as it is called; that is, to overcome the loss of lift due to the altitude to which the balloon is taken, to the lower temperature of the upper air, and to the oncoming shades of night. Except in storm, all is now serene until morning. With sunrise, and usually a partly clouded sky, troubles begin. Unless unchecked, the balloon may rise to a great height, with consequent rapid descent and enormous sacrifice of ballast. One balloon was thus put out of the national race.

If the morning is bad, the afternoon is usually worse, and the coming on of the second evening finds the ballast and the pilots' endurance badly spent. It is a question whether there remains enough ballast to weigh into the second night.

Running into a Storm Center

The end of the first twenty-four hours of the 1920 national race found five of the eleven starters still in the air. Our navy balloon had just crossed the Ohio river, and was trailing. The trail-rope was caught around a tree. There were some four hundred pounds of ballast and other disposable items aboard. The wind was about eighteen miles.

We could get through the night—that was clear; but that we would find ourselves at daybreak approaching the Great Lakes with practically no ballast reserve was equally clear. We were running into a storm center, with increasing velocity of the surface wind. In the morning we might not be able to dispense with the basket to advantage, and the maneuver might be out of the question in the higher wind. So we decided to get rid of this heavy basket while we could.

The basket touched the ground; the time was noted; the basket was detached; the remaining ballast and equipment were secured to the rigging, to which we pilots betook ourselves as soon as the trail-rope was disengaged from the tree.

The balloon rose thirteen and one half minutes after the basket touched the ground, reaching sixty-nine hundred feet above sea-level. By careful maneuvering it was brought down to about fifteen hundred feet; and there, with little difficulty, it was maintained throughout the night.

Thirteen Hours in the Rigging

For lack of a basket, we pilots had to cling to the cordage and a wooden ring during the final thirteen hours of the race. The ballast and remaining equipment was stowed on a piece of canvas. This, with a pair of ropes across the load-ring, formed a sort of seat, our legs hanging outside and over the edge of the ring. We held on to the cordage and to each other. Movements had to be rather carefully accomplished, such as placing instruments, getting out flashlights, and handling ballast. Legs and hands insisted on going to sleep.

Half an hour after midnight, we passed directly over the center of the city of Indianapolis. There was too much noise below for people to hear our calls through the megaphone, and two messages thrown overboard were unnoticed.

Morning brought Sandusky bay in sight. Course and speed, and remaining ballast, were rapidly checked up. It was found that on our course, the balloon would traverse Lake Erie lengthwise for a least one hundred and thirty miles, and perhaps over two hundred miles. A storm had been overtaking us during the night; its thunder alarmed us.

We made a quick calculation—speed per hour, twenty miles; time for one hundred and thirty miles, six and a half hours; nearest rain ahead, twenty miles; ballast to counteract temperature drop, sun to cloud, one hundred pounds; ballast to offset rain-water on balloon, two hundred pounds, sand ballast available, one hundred and forty-six pounds; other disposable load, about seventy pounds. To proceed beyond the shore-line meant a deliberate sacrifice of the balloon, and a credit by the contest committee of distance only to the point where we crossed the shore. Conclusion: land at a favorable spot before reaching the coast.

There was no difficulty in the landing, because when ripped at an elevation of twenty feet, the balloon deflated almost instantly. The weight of the remaining equipment was noted and the balloon rolled up for shipment.

The Basket Gone, They Clung to the Rigging

"We were running into a storm center. In the morning we might not be able to dispense with the basket to advantage. We decided to get rid of it while we could, and proceed."

Thus nonchalantly does Lieutenant Raffe Emerson speak of the decision that resulted in thirteen long hours spent in the rigging of a balloon.

With Lieutenant Sloman, Lieutenant Emerson represented the navy in the National Balloon race of 1920, which started from Birmingham, Alabama, on September 25, 1920. The race was to determine the selection of two crews who would, with Ralph Upson, holder of the international championship, make up a defending team of three balloons against the challenge of France, Belgium, and Italy.

The greatest distance was made by H. E. Honeywell, and the next greatest by Lieutenant Thompson in an army balloon

Letting it down easy. Pinching an egg between a casting and a heavy weight

Making a Heavy Crane Obey at a Touch

THIS is a very obedient crane—so obedient, in fact, that it will lower a ton-and-a-half weight on an egg without breaking it. Of course, the weight cannot rest on the egg—it must just touch it. The demonstrator held the egg on a large ring casting and signaled to the crane operator to lower the heavy weight. Down, slowly down, came the weight, until it rested on the egg. The signal to stop was given, and the demonstrator withdrew his hand, leaving the egg in place tightly held between the weight and the casting on the floor.

Sensitive crane control is oftentimes necessary in constructional work when a large body must be lowered and placed in a certain position. This is the case in placing heavy girders and in assembling heavy machinery in large machine-shops.

Storage-Tanks Now Come in Sections

UNPACK the pressed-steel plates, carry them one by one up to the roof or out to the place where the tank is to be erected, and you have the simplest method of putting up a storage-tank for liquids.

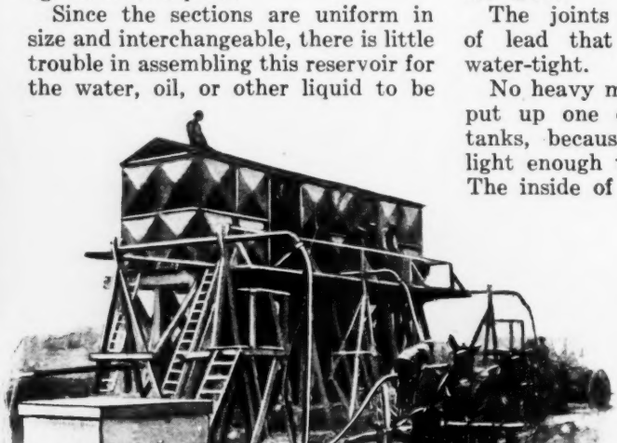
Since the sections are uniform in size and interchangeable, there is little trouble in assembling this reservoir for the water, oil, or other liquid to be stored. The size of the tank depends upon the number of pressed-steel plates utilized, and various sizes of these can also be obtained. In this remarkable tank bolts instead of rivets are used.

The joints are lined with strips of lead that serve to make them water-tight.

No heavy machinery is required to put up one of these "knockdown" tanks, because the steel plates are light enough to be carried by hand. The inside of the tank is braced by steel rods.

The plates are squeezed by hydraulic presses to give them the maximum strength with the least weight.

With these plates the height of the tank can be increased without the necessity of drawing off the contents, if a tank of greater capacity is wanted.



The tanks are built of pressed-steel plates joined by bolts and made waterproof by lead strips

A Train that Straddles the Track

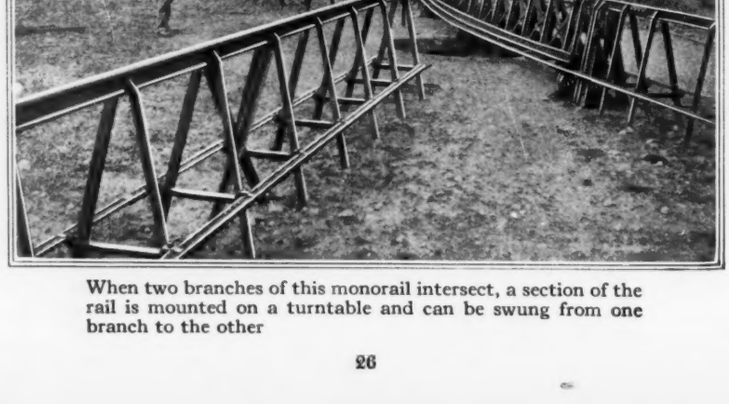
BALLYBUNNION, on the coast of Ireland, is famed, first, for its excellent bathing beaches and, second, for its strange monorail railway that connects it with the town of Listowel, ten miles away. A French engineer named Lartigue designed and built the railroad several years ago at the small cost of fifteen thousand dollars a mile, and it has been operated successfully ever since.

The single rail that carries the trains is mounted on A-shaped trestles three and a half feet high. Auxiliary rails are placed on the sides of the trestles about one foot from the ground to assist in smooth running and balancing. Small wheels on the inside of the peculiarly shaped cars ride on these rails.

What are the advantages of this particular monorail system? In the first place, groundwork is practically eliminated. The trestles rest in small trenches, and are reenforced with ballast. By lengthening or shortening the legs of the trestles, the natural sloping of the land can be followed. Furthermore, the trestles do not obstruct the natural escape of rain and snow. Thus drains or aqueducts are not needed. Exceedingly sharp curves can be safely built on this railroad, since the center of gravity of the cars is below the point of suspension.

The cars and locomotives are built with both sides exactly alike. The locomotives, for instance, have two boilers that are joined at the top. The passenger-cars carry twenty-four people apiece.

In rounding a curve a train can travel at twenty-five miles an hour without any tendency to oscillate.



When two branches of this monorail intersect, a section of the rail is mounted on a turntable and can be swung from one branch to the other

Who Will Fly the Pacific?

THE Pacific ocean yet remains to be conquered by the airship or the seaplane.

Following the American coast to the Behring straits, where the sea crossing is but 25 miles, a total of 5400 to 7800 miles would have to be flown. Crossing the ocean directly, using such islands as Hawaii as a stopping-place, the water stretches would be 2090 and 3400 miles, within easy range of a dirigible.

Adventures in Street-Corner Astronomy

By Latimer J. Wilson

IN Union Square, New York city, every clear night, you can see a large telescope pointed at the sky. Arthur F. Nursey made the telescope, and acts as a guide to the sight-seeing expedition into starland. He is one of those street astronomers who have acquired much information about the wonders of the heavens and who find pleasure in educating the crowd to the things above their heads.

On Forty-second street, near Bryant Park, Joseph G. White keeps watch of stars. He has traveled about the country with his telescope, and finds New York a good place for satisfying the curiosity of the crowds.

Few people know enough about the planets to appreciate what they see. Through the telescope, Mars, when near opposition, appears, when magnified more than 500 diameters, as a round full moon three times larger than the earth's satellite.

An intelligent young woman took a look at Mars one night when the moon was not present. "How can you show the moon when it is not visible in the sky?" she asked. She was astonished to find that she had mistaken Mars for the moon.

The street astronomer has many amusing experiences with people who stop to look and ask questions. Showing Saturn one night when the beautiful system of rings was widely open, surrounding the ball of the planet like a ring of tinted ivory, a man stopped and looked steadily at it.

"This is a fake!" he exclaimed. "There isn't any such thing in the sky. You've got this thing fastened here in the tube to fool people."

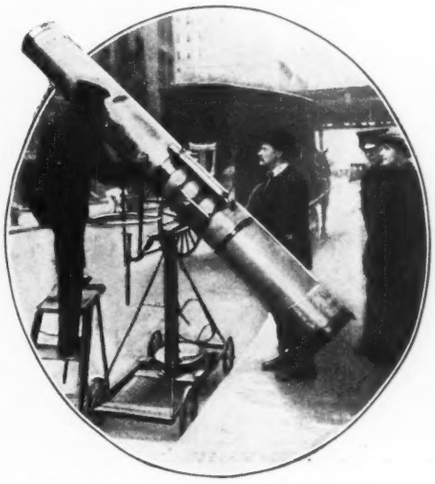
The street astronomer proved that Saturn was real by telling the man to watch it move out of the field of view by himself moving the telescope tube.

Joseph White once took his telescope into a small country town in Georgia. He went to the mayor for a permit, and was directed to a small house, where he found the mayor working in the cabbage-patch in his back yard. He explained what he wanted.

"Well, I don't know what you've got," said the mayor, mopping his brow. "But put it up in the street tonight and I'll come around to see you."

White had the telescope in working order, trained on the belted planet Jupiter. A crowd of negroes and curiosity-seekers surrounded him and watched the telescope with interest, but not one would accept the invitation to take a look through it. Finally a big man came along, flashing a sheriff's badge.

"What's this thing you've got here?" he demanded. He looked at Jupiter, and listened to the explanation about this planet and its retinue of moons. He asked questions and was interested.



Arthur F. Nursey, with a homemade twelve-inch reflecting telescope, shows the sun or the moon to the crowds in Union Square. A reflecting telescope has a mirror instead of a lens

On Forty-second street in New York, Joseph G. White shows the new comet or the planets through his 4⅛-inch refracting telescope

"It's all right," he said, "just so's you don't block traffic."

As there was no traffic to block, this meant unqualified approval. Seeing that nothing happened to the sheriff when he looked through the cannon-like telescope, the crowd clamored for a view of Jupiter. A charge was made, and business in that town was good for a few weeks, until everybody from the livery-stable boy to the Episcopal minister had seen all that was offered for sale in the heavens.

The street astronomer has his distinct place in the educational zones of society. It is strange to see a homeless tramp gazing at the shadowy valleys on the moon or the glittering beauty of the Milky Way. He realizes that life is less than a "tick" in the great clock of eternity. It gives a man a less poignant view of his picayune existence to see his hardships so belittled.

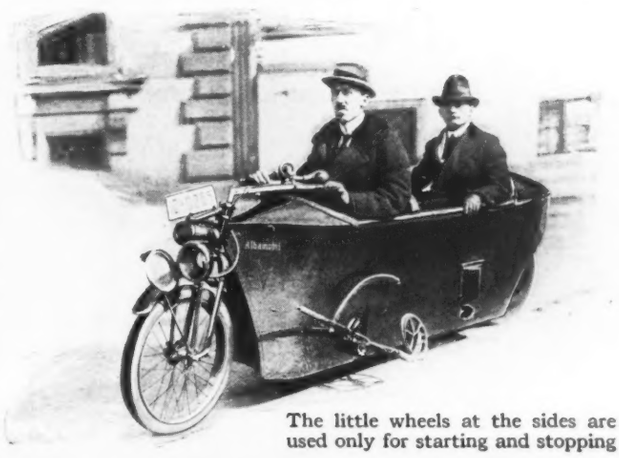
Giving the Motorcycle a Body

WHY not put automobile bodies on motorcycles? In the picture to the right you see a motorcycle that has been treated in just this fashion.

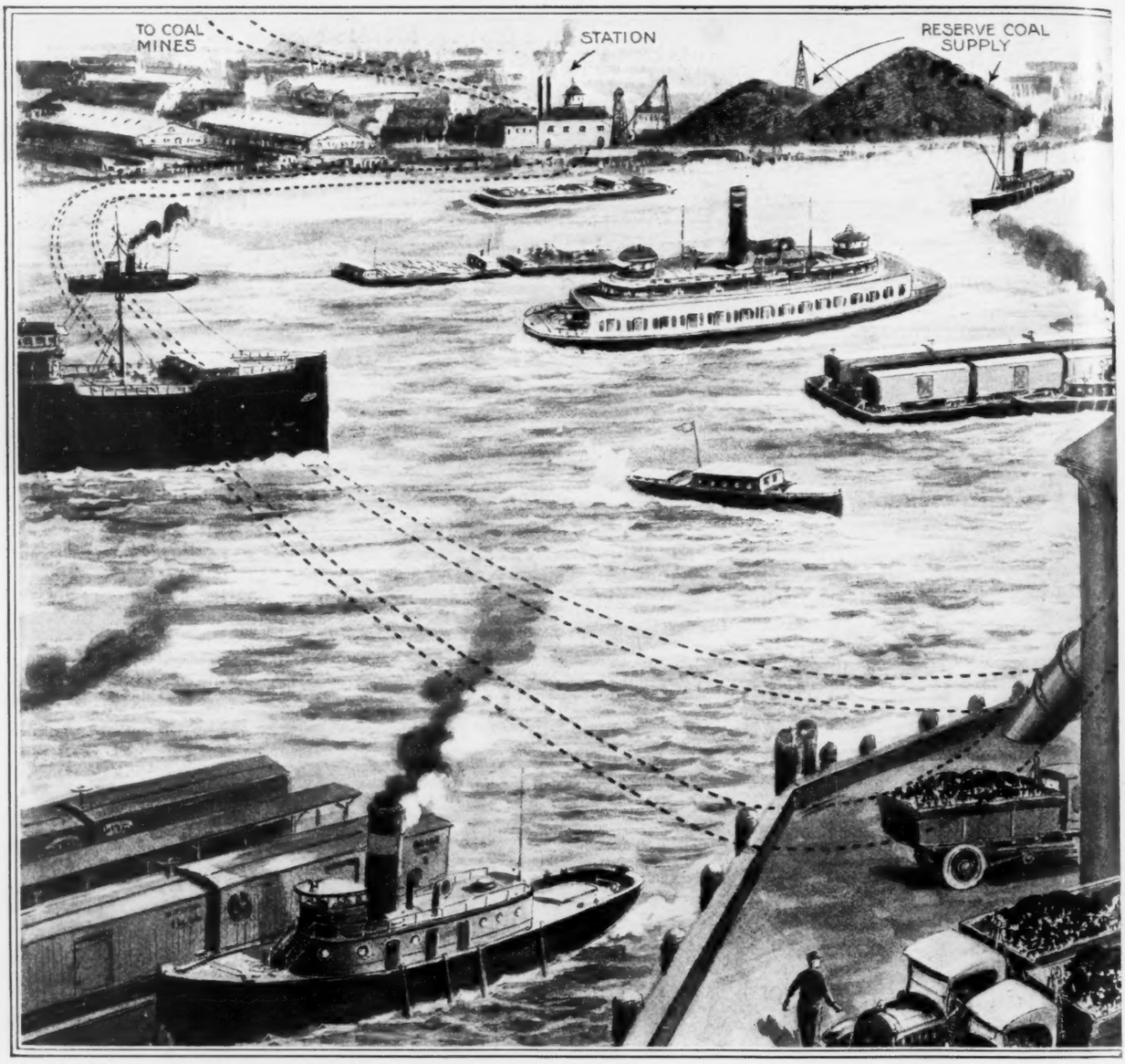
Both the driver and his passenger are provided with comfortable seats; these seats have upholstered backs and sides on which the riders may rest their arms. Their feet are entirely hidden by the automobile body, which extends to within a few inches of the ground.

You will notice a small wheel attached to the visible side of the body—there is another one on the other side. These small wheels are controlled by a lever which the driver operates. He lowers the wheels until they touch the ground whenever he wishes to start or stop the motorcycle. The wheels help maintain balance while the motorcycle travels at low speed.

Ordinarily the driver does this with his feet, but his sitting position in the automotorcycle makes it impossible for him to use his feet to advantage.



The little wheels at the sides are used only for starting and stopping



The big pipe lines carrying coal from mine to city would follow the railroads from Scranton to New Jersey. The coal would be stored in New Jersey and sent to New York as needed, huge pipes conveying it under the North river

Piping Coal to

How Reginald Bolton would feed New York

IF this scheme is adopted, seven million tons of coal a year may literally pour into New York city. The coal will be ground at the coal-fields, mixed with water, shot into two fourteen-inch pipes, given a terrific impulse, and sent on its 250-mile journey to New York.

Two Rushing Black Streams

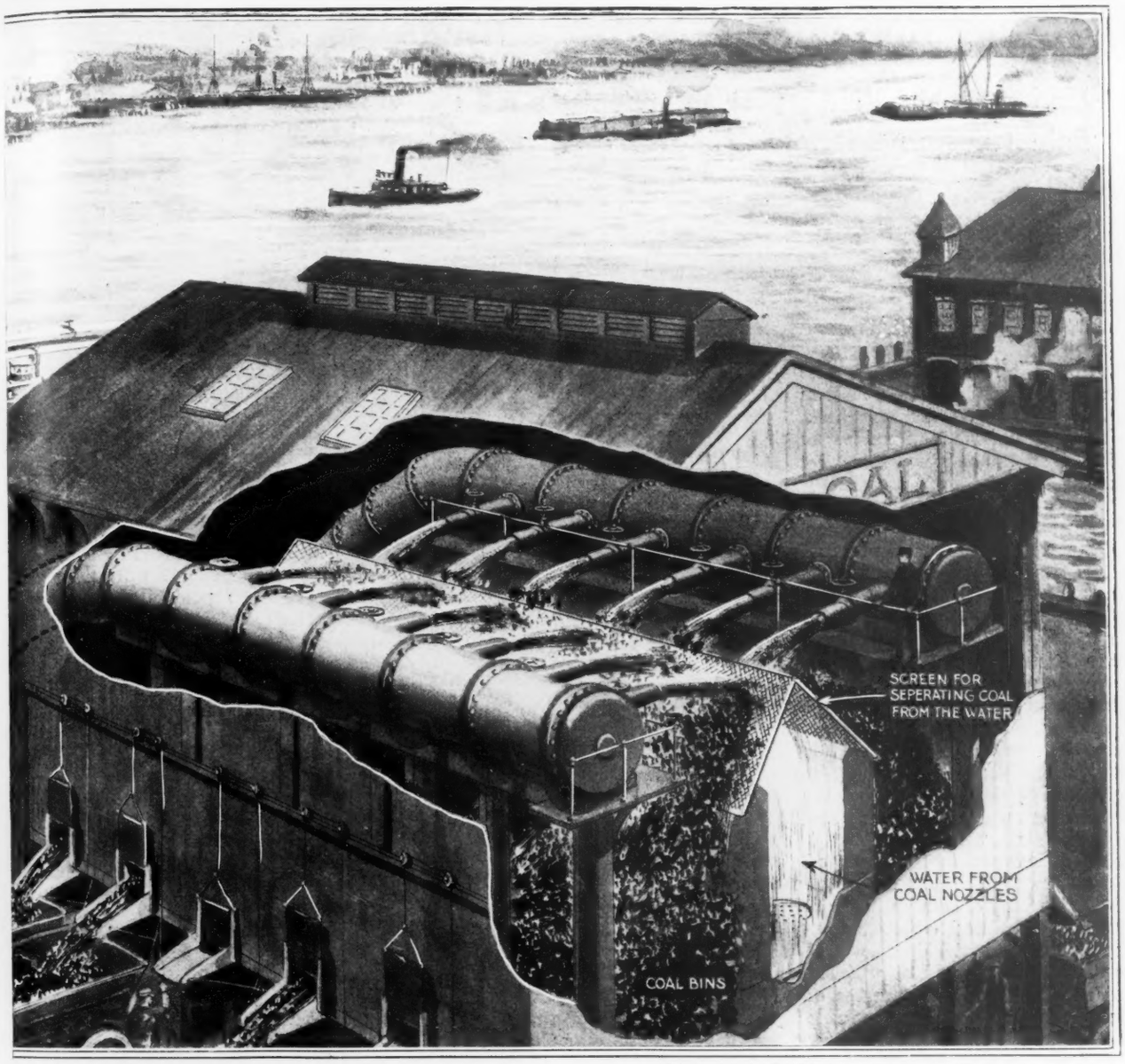
Imagine a rushing mass of coal, fourteen inches in diameter, traveling at the rate of an express train! Over river, hill, dale, and valley it speeds, gushing through towns and hamlets on its way. Here and there it enters a pumping station, receives another impulse—another kick so to speak—that sends it on with renewed vigor.

Two great black streaks of coal will pour into the Jersey swamps opposite New York, where they first gush forth into the light of day. Here they will strike large screens, and the water and coal will part company. The coal, unable to pass through the screen, will bound back, descend a slope, drop into a bucket conveyor, and be whisked away to the top of the coal-pile outside. Here the coal will remain until it is needed in New York, when it will again be picked up, mixed with water, and sent off on the final leg of its journey under the Hudson river. When it reaches the coal station, it will drop into great bins, finally roll out into waiting trucks and be rushed away to the consumers.

Following such a system as this, coal that was brought to the surface in the morning by a miner could be burning under the boilers of one of New York's large buildings before evening.

The Car Problem Solved

New York city consumes about seven million tons of coal a year. Two big pipes could easily supply this need. But would the cost be prohibitive? It would not, considering the economic importance of the problem. Twenty million dollars would place such a system in operation and forever relieve New York of the fear of a coal shortage. The car problem to-day is an ugly one. Continuity of operation at the mines depends entirely upon an un-



Upon reaching New York, the mixture of water and coal would be dashed against a screen, separating the water from the coal. The water would pass into a settling tank, where the fine coal would be recovered. The heavy coal would fall back into bins

New York City

with coal through two big pipes

ending supply of cars. Few mines are able to work through a whole day, because the cars are not available.

The system of piping coal has been used in England for some time. On a small scale, the method has been used by a large manufacturer in the city of London since 1915. Here fifty tons of coal an hour is pumped a distance of 1750 feet at a cost of six cents a ton.

Crude oil has long been pumped over great distances. A big oil company in Buffalo receives its crude oil, in an unending stream, from the oil-fields of Pennsylvania through several large pipes. This is far cheaper than transporting it in tank-cars. In California oil is pumped a distance of one hundred and seventy miles. The cost is a small fraction of a cent a gallon.

It has been estimated that a modern equipment for the transportation of coal by the pipe method could be operated over a distance of thirty miles, delivering coal at its destination at a cost of eight tenths mills a ton-mile, inclusive of fixed charges and depreciation. This remarkably low cost could not be duplicated by any other known method of transportation.

The Water Will Preserve the Pipes

The practical man may ask: "How long will such a pipe last? Won't the abrasion of the coal wear it out in a short time?" Few people realize that water is a wonderful lubricant. We are reminded of this when we see a trolley-car slipping along the rails on a thin film of water. The lubricating property of water would offer ample protection to the pipes.

Scranton, which is in the center of the coal-fields, is about two thousand feet higher than New York. This difference in level would aid in speeding up the coal and reducing the actual cost of delivery. With this factor considered, Mr. Bolton believes that coal can be brought into New York at a transportation charge of seventy-five cents a ton. He also believes that the continuity of operation at the mines made possible through the use of this system would effect a still greater saving. In all, this saving would cut about two dollars and fifty cents off a ton of coal, resulting in a total of about seventeen million dollars a year.

Two Paintings on the Same Canvas

Under a white light a portrait appears; a red light transforms it into a man and a horse

By M. Fitzhugh Browne

LOOK at the two pictures at the bottom of this page—the portrait of the lady and that of the man and horse. When seen in an ordinary light, the portrait of the lady appears; but the instant a red light is thrown on the canvas, or it is seen through a red filter, it becomes in a flash the picture of the man and horse. How is this done and how can the changes in illumination so completely alter the appearance of the paints used in the two pictures?

The answer lies in the physical characteristics of pigments and their differing powers of reflecting light. These differences have long been known in a general way to scientists, and have heretofore been looked upon by them as a nuisance and a factor to be discounted in their experiments with light rays and color. Now, however, Charles Bittinger, a scientist who is primarily an artist, has hit upon the idea of utilizing these differences, increasing them where possible, and making them serve his purpose.

During the war Mr. Bittinger served in the department of camouflage of the United States Navy, conducting experiments in the reflection and transmission of light-waves. By means of the spectro-photometer, he established the reflective powers of a number of pigments and dyes that had invisible spectral differences, and, with a palette set with paints similar in color when seen in a white light, but contrasting sharply in degrees of light and dark when seen under a red light, painted his twofold pictures, using round brushes for one series of paints and triangular ones for the other, to avoid confusion in the work.

Showing the position of two pictures laid on one canvas, one over the other. Different light brings out the different pictures

For instance, he might have on his palette two greens that appeared identical in an ordinary light, but that reflected a red light so differently as to make one look much darker than the other in that illumination. Therefore a picture of a tree whose leaves were painted with both greens would, in an ordinary light, have luxuriant summer foliage, whereas in the red light it would change to the bare boughs of winter.

The stage, with its demands for instantaneous and mystifying transformations, furnishes a very fertile field for this new art. In Mr. Bittinger's New York studio is a miniature stage set with a scene on the Riviera, which immediately changes to Madison Square in winter when the red light is switched on. Costumes, too, can be handled in endless effective ways by applying the principle to the dyes used and to the patterns in which the colors are put on. A chorus might come dancing on in dresses with horizontal stripes. The light changes—and instantly the stripes are vertical; and so on in infinite variety.

Advertising, also, with its many needs for "before and after using," or similar illustrations, is a sphere in which some striking results can be obtained; and there are even possibilities of house decoration—a frieze that would appear of one color and pattern by daylight and of an entirely different design by artificial light.

Charles Bittinger, who during the war served in the camouflage department of the United States Navy, at work on his two-in-one painting

Mr. Bittinger has painted an airplane wing with the German cross upon it, which when viewed by our army through binoculars equipped with a red filter, discloses itself to be, not the German cross, but the red, white, and blue of the Allies. Thus an airplane could fly unscathed over the German lines and return home again without being fired upon.

This was only one of the ideas that Mr. Bittinger had in mind when the armistice put an end to the need of such devices, but they serve to show how extensive and really valuable are the possibilities of the remarkable invention.

In an ordinary white light you see this portrait of a lady. The secret of the mystery is that pigments possess differing powers of reflecting light

The instant a red light is thrown on the painting of a lady shown on the left of this page, it turns into this picture of a man and a horse

Motor-Boats Equipped for Life-Saving

IN most places situated on the water life-savers keep watch in rowboats that are equipped with a few life-belts. But this protection is inadequate in many instances. On large lakes, for example, a small boat is apt to sink far from shore, and its occupants may drown before a life-saver can row out to them.

On the lakes around Berlin, Germany, life-savers travel in high-powered motor-boats that are equipped with pulmotors, medicine-cases, and stimulants. There are also life-buoys, life-lines, and boat hooks on board, as preparation for every kind of emergency.

Each boat carries three men—the pilot, a machinist, and a trained ambulance man. They all must be strong swimmers.

The twelve-knot boats cruise up and down the lakes and are always ready to answer any emergency call.

Now that fuel is scarce and so expensive in Germany, it has been suggested that the boats be stationed at regular intervals, and that small look-out towers be built on board. With the aid of a telescope one of the crew can keep watch. If the innkeepers and householders along the shore are supplied with light-pistols, they can signal the boats in case of accident along the shore at night.

On the lakes in the neighborhood of Berlin, life-savers use fast motor-boats equipped with medicine-chests and resuscitating apparatus. Had it been necessary to carry this man to shore for treatment, he would probably have died

The picture shows a man, who was nearly dead when rescued, being resuscitated on board one of these specially equipped motor-boats. The apparatus to the left is being used.

The salesmen in the center, faced by gunmen, not making any apparent attempt to fight their assailants. Notice the "Repairing" sign outside the shop

The sign changes to "Help! Police!" For, while the salesmen held up their hands, in apparent nonchalance, they cautiously pressed electric buttons set in the floor

Calling the Police while Robbers Point Guns

"HELP! Police!" These words, flashed in white letters on a red sign, had all the effect on several passers-by of a shout.

For the sign was hanging outside of a jewelry shop in the diamond district of New York, and the minds of the hurrying pedestrians were full of newspaper accounts of the various daylight robberies that heralded the city's "crime wave"—reputed to have come from farther west.

The police quieted the nervous ones by explaining that they were in on what was going on, and that it was merely a try-out of an anti-burglar device.

Meantime, what was going on inside the shop? An alleged burglar flourished a pistol at three clerks, who obediently threw up their hands. At the same time, with their feet they felt cautiously but surely for a sort of trip-board running along the floor back of the counters and set at close intervals with push-buttons connected with the sign outside the door that ordinarily bears the sign, "Repairing." This sign immediately changed to "Help! Police!"

The apparatus is independent of the regular electric system, being worked by a storage battery.

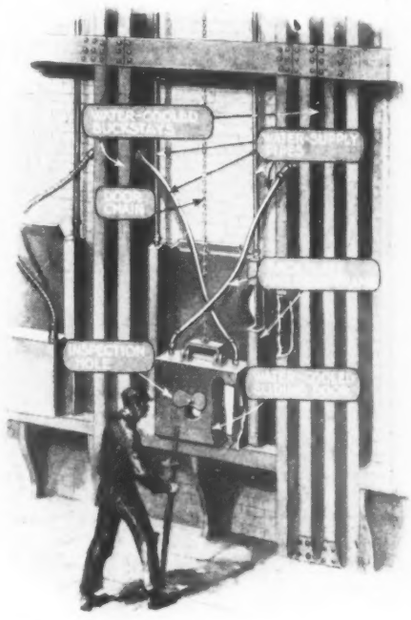
An important part of this burglar alarm is a loud steam-whistle that can be heard six blocks away, but the police did not allow this to be tried on the populace.

Keeping the Boiler Fireman Comfortably Cool

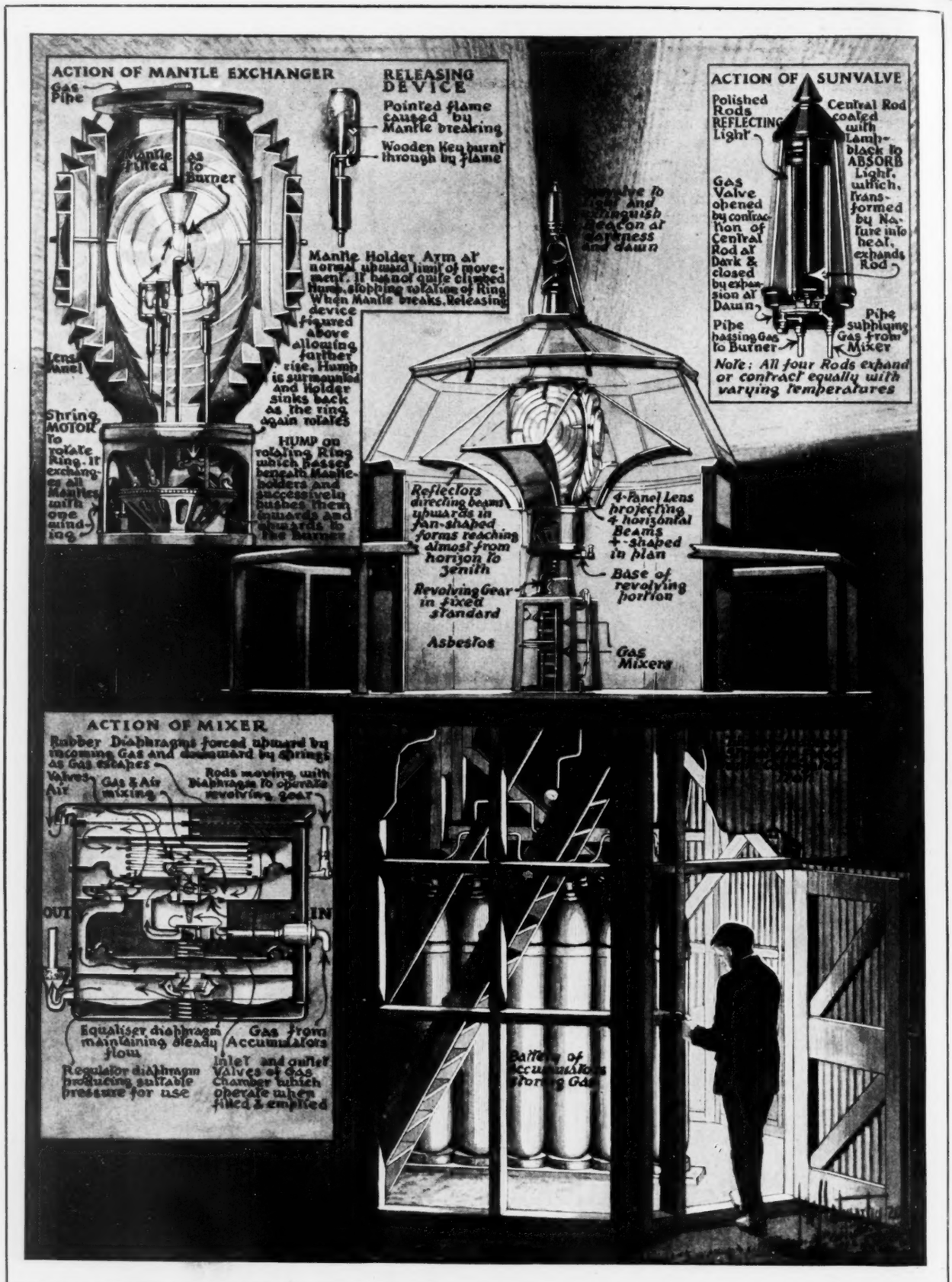
THE man who stands in front of a roaring furnace all day, feeding it with coal, has a hard life. It is not so much the manual labor that weakens him, but exposure to terrific heat. Now comes the water-cooled door and door-frames. Men can work in front of a furnace equipped with these water-cooled devices, without much discomfort.

Water-cooled doors are made of pressed steel, with the various parts welded together. Water circulates through the hollow door, carrying with it much of the heat that would otherwise radiate into the boiler-room. A peephole is placed in the center of the door, so that the fireman may watch his fire. Flexible hose connections make it possible to raise and lower the door to feed the fire.

Various other parts of the boiler may be kept cool by this means.



Water-cooled doors now protect the fireman from exposure to the terrific heat that formerly shortened his life


ACTION OF MANTLE EXCHANGER
Gas Pipe
Mantle as fitted
To Burner
Lens Panel
Spring MOTOR to rotate Ring. It exchanges all Mantles with one winding
RELEASING DEVICE
Pointed flame caused by Mantle breaking
Wooden Key burnt through by flame
Mantle Holder Arm at normal upward limit of movement. If hand quite climbed Hump stopping rotation of Ring When Mantle breaks, Releasing device figured above allowing further rise. Hump is surmounted and Holder sinks back as the ring again rotates
HUMP on rotating Ring which passes beneath Mantle-holders and successively bushes them inwards and outwards to the Burner
ACTION OF SUNVALVE
Polished Rods REFLECTING Light
Central Rod coated with Lamp-black to ABSORB Light, which, transformed by Nature into heat, expands Rod
Gas Valve opened by contraction of Central Rod at Dark & closed by expansion at Dawn
Pipe passing Gas to Burner
Pipe supplying Gas from Mixer
Note: All four Rods expand or contract equally with varying temperatures
Reflectors directing beams upwards in fan-shaped forms reaching almost from horizon to Zenith
4-Panel Lens projecting 4 horizontal Beams +-shaped in plan
Base of revolving portion
Revolving Gear in fixed standard
Asbestos
Gas Mixers
ACTION OF MIXER
Rubber Diaphragms forced upward by incoming Gas and downward by springs as Gas escapes
Valves Air
Gas & Air mixing
Rods moving with Diaphragm to operate revolving gear
OUT
IN
Equaliser diaphragm maintaining steady flow
Regulator diaphragm producing suitable pressure for use
Gas from Accumulators
Inlet and outlet Valves of Gas Chamber which operate when filled & emptied
Battery of Accumulators storing Gas

© Modern Publishing Company

Drawing by S. W. Clatworthy

Blazing the Airman's Trail in the Night Sky

IN England the first aerial lighthouse has been in operation since April, 1919. Sunlight automatically lights and extinguishes the incandescent torch, which sends into the night sky a blazing stream of light.

Aviators in the near future will be guided across the continent by extended rows of such lighthouses.

The lighting mechanism consists of a dead-black cylinder that absorbs the light and heat from the sun. Inside is a metal rod, which expands or contracts under the heat action.

The contraction of the central rod opens a gas-valve that admits the gas to the burner. At dawn the rod expands and cuts off the gas.

At the coming of night the light begins to revolve, the acetylene gas-mantle is automatically lighted, and fan-shaped rays are cast into the sky.

Its Wings Carry the Engines

The eighteen-passenger airplane

By Latimer J. Wilson

AN airplane with four engines built *in* the wings of the machine is the latest style of giant air-cruiser. The machine is in the form of a monoplane having a wing-spread of one hundred and five feet. The wings are thick enough to accommodate the engines, which are fitted into the strong metal frame. Since aluminum is used in the structure, one might question the possibility of rivets in this soft metal holding under the strain of the perpetual vibration imparted by the motors. It would seem that the persistent vibration might tend to enlarge the rivet-holes.

A New Feature

The monoplane carries eighteen passengers and can attain a speed of one hundred and thirty miles an hour. One remarkable feature is the manner in which the passengers are admitted to the cabin. In other machines the door is in the side of the cabin; but here it is located in the front of the fuselage. The outside of the door is pointed, to "streamline" the flow of air currents. The passengers are seated on two sides of the aisle, as in a parlor Pullman, and spacious windows afford a view of the passing cloudscape. The pilot's seat is on the "upper deck," where he can command a good view of all except the ground immediately beneath, so his landing is necessarily a matter of nice judgment.

Because of its clumsiness, it is more difficult to "land" a large airplane than a small one, which is easily understood on looking at the picture below. This mammoth monoplane, designed by Rohrback, is being used by the Staaken airplane factory, but its ultimate success in air travel is doubtful. When first built, the wings were unsupported except from the body of the machine. An accident disclosed that these must be further strengthened by outside struts. In addition, wire bracing is used to further strengthen the wing structure.

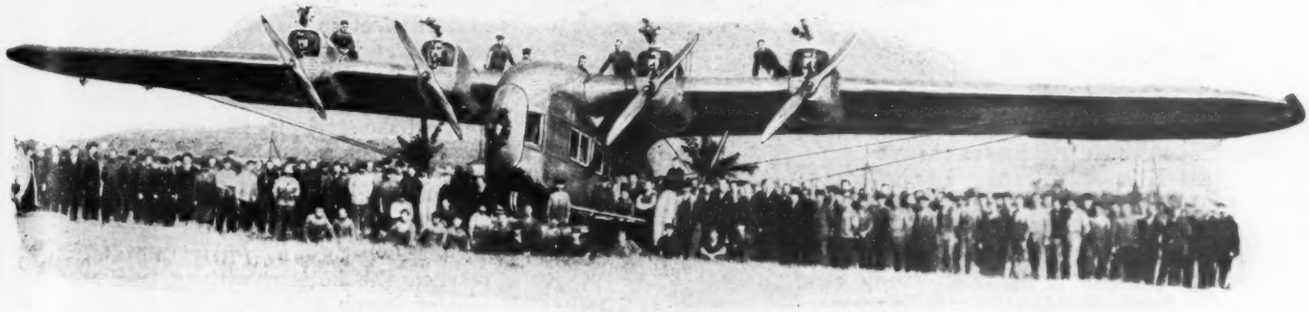
In the huge metal monoplane the passengers enter through a front instead of a side door. Eighteen passengers can be carried

The successful airplane of the future will perhaps be one of all-metal construction, but not all the same kind of metal. The material best suited to each particular part of the construction will eventually be found, and then a perfect flying-machine will be the result. The use of soft materials such as aluminum when rivets are used will be confined to non-vibrating parts so the rivets will not wear themselves loose in the soft metal.

Traveling 130 miles an hour, the monoplane, with wings 105 feet from tip to tip, makes its way through the air like a gigantic hawk

Possibilities of the Future

Not only will the engines be placed within the wings of the future airplane, but possibly the passenger compartments will be housed there as well. Other structural forms may place the engines far back in the fuselage with propellers extending back of the wings driving the craft through the air almost as a vessel is propelled through the water. The flying and landing speeds will be easily made, and the future airplane will be able to alter its wing-surface during flight. What dare we define as a limit for the airplane of the future?

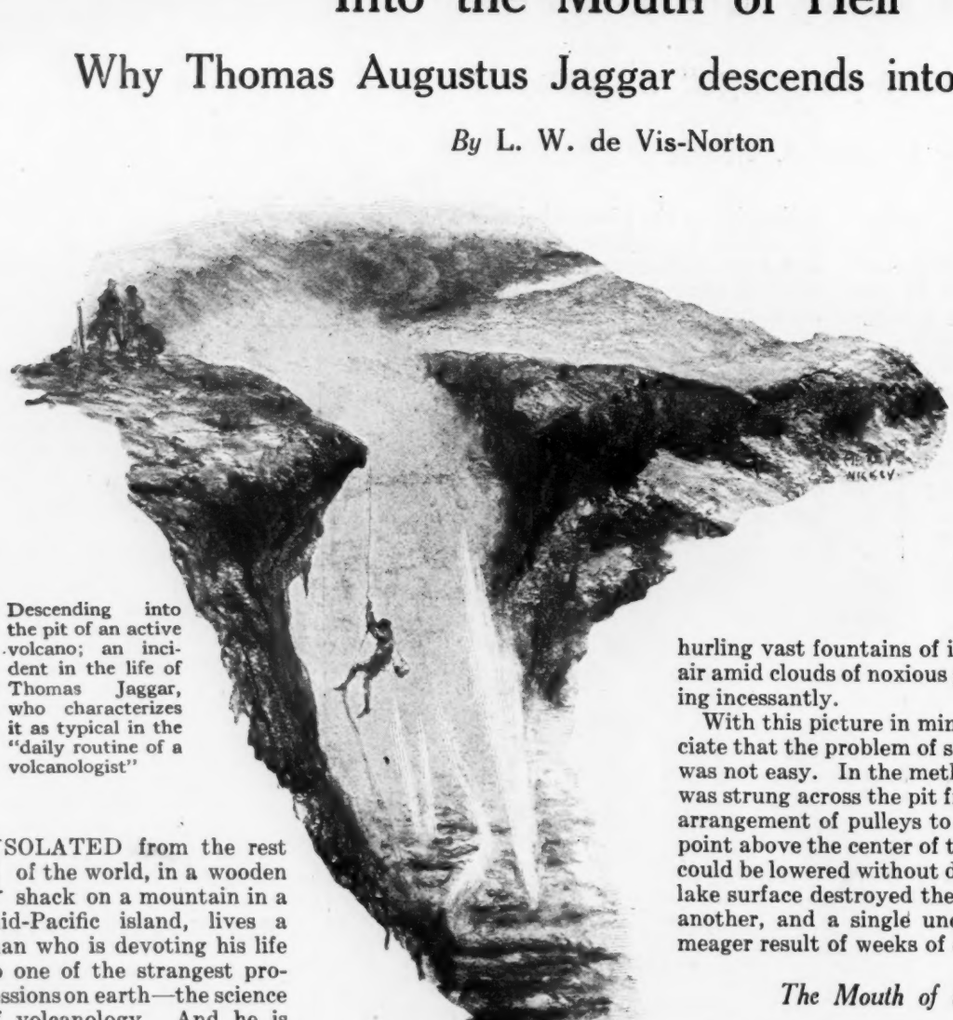


The size of the crowd and the size of the metal airplane can be compared to impress one with the size of the air-cruiser. The four 250-horsepower engines are installed in the wings of the machine

Into the Mouth of Hell

Why Thomas Augustus Jaggar descends into volcanoes

By L. W. de Vis-Norton



Descending into the pit of an active volcano; an incident in the life of Thomas Jaggar, who characterizes it as typical in the "daily routine of a volcanologist"

ISOLATED from the rest of the world, in a wooden shack on a mountain in a mid-Pacific island, lives a man who is devoting his life to one of the strangest professions on earth—the science of volcanology. And he is making discoveries that will help to avoid the toll of thousands of lives that often follows volcanic eruptions.

Thomas Augustus Jaggar went to Martinique in 1902, shortly after the volcanic destruction of St. Pierre. A study of the causes and effects of this eruption quickened his already keen interest in volcanology, and he subsequently made expeditions to Vesuvius, Costa Rica, and the Aleutian chain. On a visit to Hawaii in 1909, he realized that in the ever-active crater of the Kilauea volcano, with its surging lake of molten fire, and in the neighboring great volcano, Mauna Loa, he had found the ideal field for his researches.

Volcanic Research in Hawaii

In 1911 Professor Jaggar established the Hawaiian Volcano Research Association, with an unpretentious wooden building on the very rim of the great Kilauea volcano. His brilliant successes there have led to the establishment of a special branch of the United States Weather Bureau devoted to volcanic research.

In order to make a thorough study of Kilauea, Dr. Jaggar decided it would be necessary to obtain temperatures of the molten lava lake in its fiery depths. To understand what this means, visualize a vast pit with a circumference of nearly one and one half miles, with crumbling perpendicular walls, constantly shaken by earthquakes and reverberating to the crash of avalanches, hurtling directly down to the wide expanse of molten magma known to the natives as the "House of Everlasting Fire."

This molten mass is a lake indeed, but unique in character; rising and falling at irregular periods; boiling and seething in white-hot waves of fire; hurling vast fountains of incandescent lava high in the air amid clouds of noxious gases; screaming and bellowing incessantly.

With this picture in mind, it is not difficult to appreciate that the problem of securing reliable temperatures was not easy. In the method first adopted, a cableway was strung across the pit from rim to rim, with a simple arrangement of pulleys to convey the instruments to a point above the center of the lake beneath, so that they could be lowered without difficulty. But the fury of the lake surface destroyed the costly instruments one after another, and a single uncertain temperature was the meager result of weeks of effort.

The Mouth of the Fiery Furnace

After this disappointment, Dr. Jaggar conceived the daring project of actually descending into the roaring pit to secure temperatures of the lava. Not to risk the loss of more costly apparatus, he devised a set of recording thermometers, the principle of which was based upon the enclosure of a battery of Seger cones, made of fusible clays, within steel pipes. It was planned to plunge these into the lake itself. Dr. Jaggar then secured a small band of volunteer assistants, one of whom gives us the following:

"Rope ladders presented the least dangerous method of descent, since the slightest displacement of a loose rock might have started an avalanche, precipitating all of us into the lava lake. We had to drop down about two hundred feet to reach a small spatter bench at the margin of the lake; but, owing to the overhang of the cliff, it was necessary to swing in slightly as we neared the bottom. We lowered the steel pipes in a bundle, and then went over the edge, Dr. Jaggar in the lead. It grew frightfully hot as we climbed down. I was more afraid of gas than anything else—we had no gas-masks.

"We went down very carefully, and reached the bottom without mishap. The spatter bench was none too wide, but appeared to be fairly stable, in spite of the fact that we could feel the lava pounding beneath it. The blasts of heat were fearful: but we set to work to screw together a few lengths of

pipe, being somewhat protected by a spatter rampart. We appeared to be below the actual lake level, and could see the big fountains splashing away to a great height.

"Dr. Jaggar said he meant to go to the top of the spatter rampart and plunge the pipes directly into the lake from there, holding on as long as the heat would allow. I volunteered to help.

"We found ourselves not more than four feet above the lake surface. It was a magnificent sight. The fountains were traveling in all directions, and appeared immensely high. But the heat was appalling, and breathing was difficult, though there was little gas.

"We crouched down upon the slippery rim, Dr. Jaggar sheltering me while the others pushed the pipe to us. Then we steadied ourselves and plunged it directly into the seething lava immediately below us. It was instantly swept aside by a strong undercurrent, and we were nearly pulled down. The pipe conducted the heat, and our hands suffered terribly even through heavy gauntlets. Dr. Jaggar got the full force of the heat, and how he managed to hang on for five eternal minutes, I don't know. At the end of that time it became apparent that a fountain was about to break right at our feet, and he gave the signal for the men to haul up the pipe. Then we slid on our backs down the rampart on to the bench just as a great fountain rose and crashed down where we had been working.

Important Findings by Dr. Jaggar

"As soon as the pipe was cool enough, we chipped away the lava and withdrew the Seger battery. We had secured a temperature in excess of 2000 degrees F." In this manner Dr. Jaggar made soundings almost entirely around the dangerous margin of the great fire-lake. During a violent eruption of Mauna Loa, in October, 1919, he succeeded in approaching within fifty feet of the actual point of outbreak, and, at the risk of his life, photographed a fountain of molten rock that was roaring out of the mountainside to a height of two thousand feet.

Dr. Jaggar has proved that there are half-hourly, daily, monthly, semi-annual, and longer-term tides and periods in the movement of great lava columns, and that these mighty engines of destruction work in the closest sympathy with one another. He has proved that it is possible to predict with a degree of certainty the approach of a volcanic disaster in any part of the world.

What a Pie-Plate Taught about the Yosemite Winds

STRAWS, we are told, show which way the wind blows. The proverb does not mention paper pie-plates or sheets of waxed tissue-paper; but Mr. B. M. Varney, of the University of California, has found both of these articles quite serviceable in visualizing the paths of the remarkable air currents in the Yosemite valley.

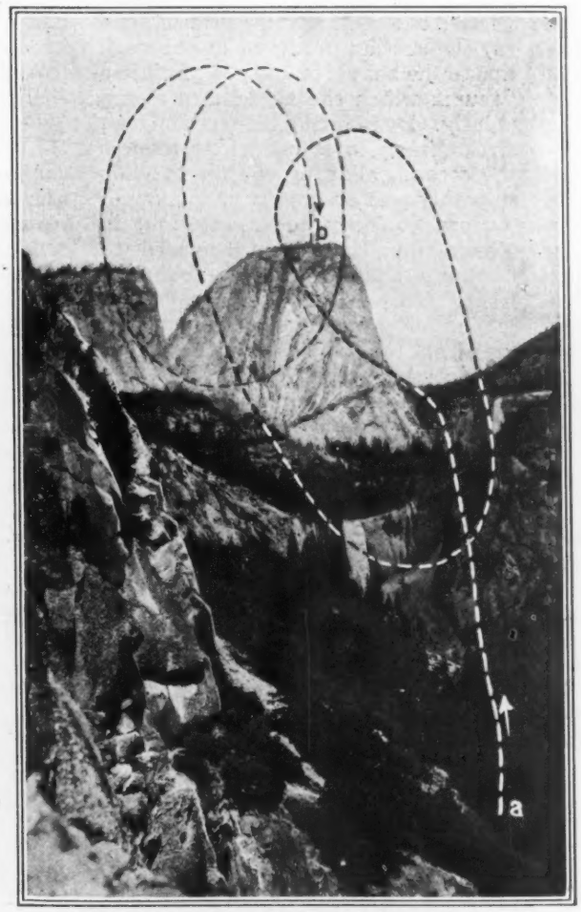
He was standing one afternoon on Sierra Point, eleven hundred feet above the floor of the valley. "Suddenly," says he, "a paper pie-plate came swirling up from below in a vertical suction current. In a twinkling the rushing currents aloft caught the plate and hustled it off upward and eastward. Thus began the flight, which was easily traced, first with the gray cliffs as background and then a clear sky."

The plate described a series of gigantic arcs on its way across the valley—now soaring far above the level of the highest peaks, and again rushing downward with a speed far too great to be due to the mere action of gravity.

This performance was so strange and so interesting, as indicating the kind of winds that prevail in the valley, that Mr. Varney spent the ensuing hour in launching broad sheets of waxed tissue-paper, in an attempt to learn whether the huge spiraling currents thus revealed were permanent.

More than a dozen paper flights were made, some of them so long that the papers were barely discernible, even with the aid of six-power binoculars. Every flight showed more or less strikingly the spiral path first noted. The most remarkable flight is represented in the accompanying sketch. This lasted nearly seven minutes. Then the paper disappeared behind Liberty Cap (*b*), the top of which is some sixteen hundred feet higher than the point where the flight began (*a*) and more than a mile distant horizontally.

Here we have an interesting example of the ticklish flying conditions that aviators often encounter in the immediate vicinity of mountains. Aerial sight-seeing in the Yosemite valley will be fraught with so many thrills that only the bravest will dare them.



A sheet of waxed tissue-paper was released at *a*, and it spiraled its way through Yosemite valley, disappearing at *b*. The peculiar air currents caused this

Toads Eat Red-Hot Charcoal

TOADS don't look as if they had much sense and their actions seem to confirm it. If red-hot pieces of charcoal are thrown in their path they gulp them down, thinking that the bits of charcoal are fireflies. This mistake is natural enough, but the stupid toads don't realize that they've made a mistake; they will gulp down a second piece just as eagerly! Some toads will eat three or four pieces. Their throats and stomachs must surely be burned, yet they do not seem to realize it.

In an article appearing in *Nature*, Mr. W. N. F. Woodland, of Maidenhead, England, tells of his observations in Allahabad, India, when he fed hot charcoal to toads. His explanation of their indifference to scorching is that the incentive to seize an object is so strong that even acute pain will not deter them.

Knowledge must be "burned" into their intelligence by many repetitions of the disagreeable experience, just as in the case of an imprisoned shark. He will repeatedly bruise his snout against the glass of his tank.

Speeding Up the Ocean-Liner and Automobile

How to reduce wind resistance

By P. J. Risdon

English correspondent of the Popular Science Monthly

THE retarding effect of headwind upon vehicles, boats, and airplanes is fully appreciated only by experts. It must be borne in mind that still air opposes a resistance to a moving vehicle equal to that of a wind of the vehicle's speed. Thus a vehicle traveling at thirty miles an hour against a headwind of thirty miles an hour is really up against a wind of sixty miles an hour. The resistance offered increases roughly as the square of the speed: thus a wind of thirty miles an hour offers a resistance to a flat surface opposed to it of four and a half pounds to the square foot, while a wind of sixty miles an hour is equivalent to a pressure of eighteen pounds to the square foot; one of eighty miles an hour produces a pressure of thirty-two pounds. Consequently, an automobile traveling at thirty miles an hour against an ordinary strong wind of the same speed encounters what is virtually a violent gale.

What Is Streamlining?

The enormous speeds attained by aircraft rendered streamlining a matter of paramount importance and it is now applied to every possible detail of airplanes with highly beneficial results.

The term "streamlining" is familiar enough, but its significance is not generally understood. It is sometimes incorrectly used in connection with modern automobile bodies, but it is only in racing-cars that really serious endeavor is made at streamlining. The position of the engine and comfort and luxury are hindrances to its scientific application.

It has already been proposed to streamline trains, and some time ago a method of doing so was described and illustrated in the Popular Science Monthly. But the streamlining of road vehicles and of ships has received scant attention beyond experiments conducted in wind-tunnels by the Bureau of Standards and other scientific institutions.

Owing to the fact that portions of road vehicles and ships present curved or sloping surfaces to the wind, it is difficult to calculate with accuracy its total retarding effect upon them. Nevertheless it is believed that by streamlining ships of twenty knots, an additional five knots could be secured for the same expenditure of energy. In the case of an automobile, if a car presents the equivalent of five square feet of flat surface when traveling thirty miles an hour against a wind of thirty miles, the continuous retarding effect is ninety pounds, which is equal to ascending a grade of 1 in 25 for a vehicle weighing with its load two thousand pounds.

The retarding effect of wind is threefold: (1) The direct pressure against the exposed surface; (2) the friction of the air as it rushes past, and (3) the suction produced at the back due to the body's tending to produce a vacuum which the air fails to fill instantly. By reducing the first and last, streamlining to some extent reduces the second, allowing the air to glide smoothly past an object.

Now, contrary to expectation, in streamlining, the rear surface needs to be more acutely tapered than the front. This is well illustrated by a section of a modern airplane strut, the front of which is blunter or more rounded than the tail end. The same principle applies to larger things.

Our picture illustrates the principle of streamlining automobiles and ocean-liners. The eddying effect of a headwind is indicated by the arrows. In automobiles one of the principal considerations is to provide a fairing or tapered tail to fill the place behind the car where suction is set up, so that the air displaced by the car may flow past it as smoothly and evenly as possible. Such details as wind-screens and mud-guards could be altered so as to offer less resistance without necessarily impairing their efficiency.

Present-Day Ships Are Wasteful

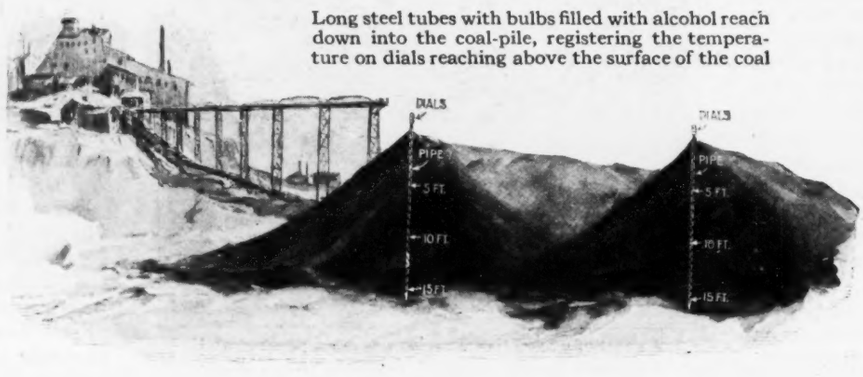
In the case of liners, one picture illustrates a typical vessel of to-day and the other the same boat as she would appear streamlined. Although her designers carried out exhaustive tests with a view to ascertaining the best "lines" and minimizing water resistance, the effect of wind was ignored—indeed, as in the case of most ships, her upper works, promenade decks, and bridges are so designed that they offer an enormous resistance to wind, while suction astern must be almost as great. Her funnels, boats, and other gear all enhance the effect and add to the consumption of fuel, loss of power and speed, and increased cost of running.

By streamlining the vessel, although the effect may be startling at first, the comfort and convenience of the passengers and crew would be in no way reduced—indeed, comfort would be considerably increased as drafts would be almost eliminated. It will be noticed that even her funnels and masts are shown streamlined.

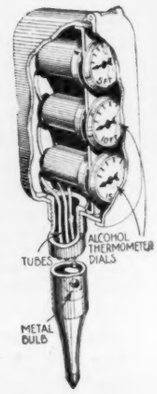
It only remains for some progressive shipping company to give the idea a serious test, notwithstanding the possible violent opposition of naval architects.

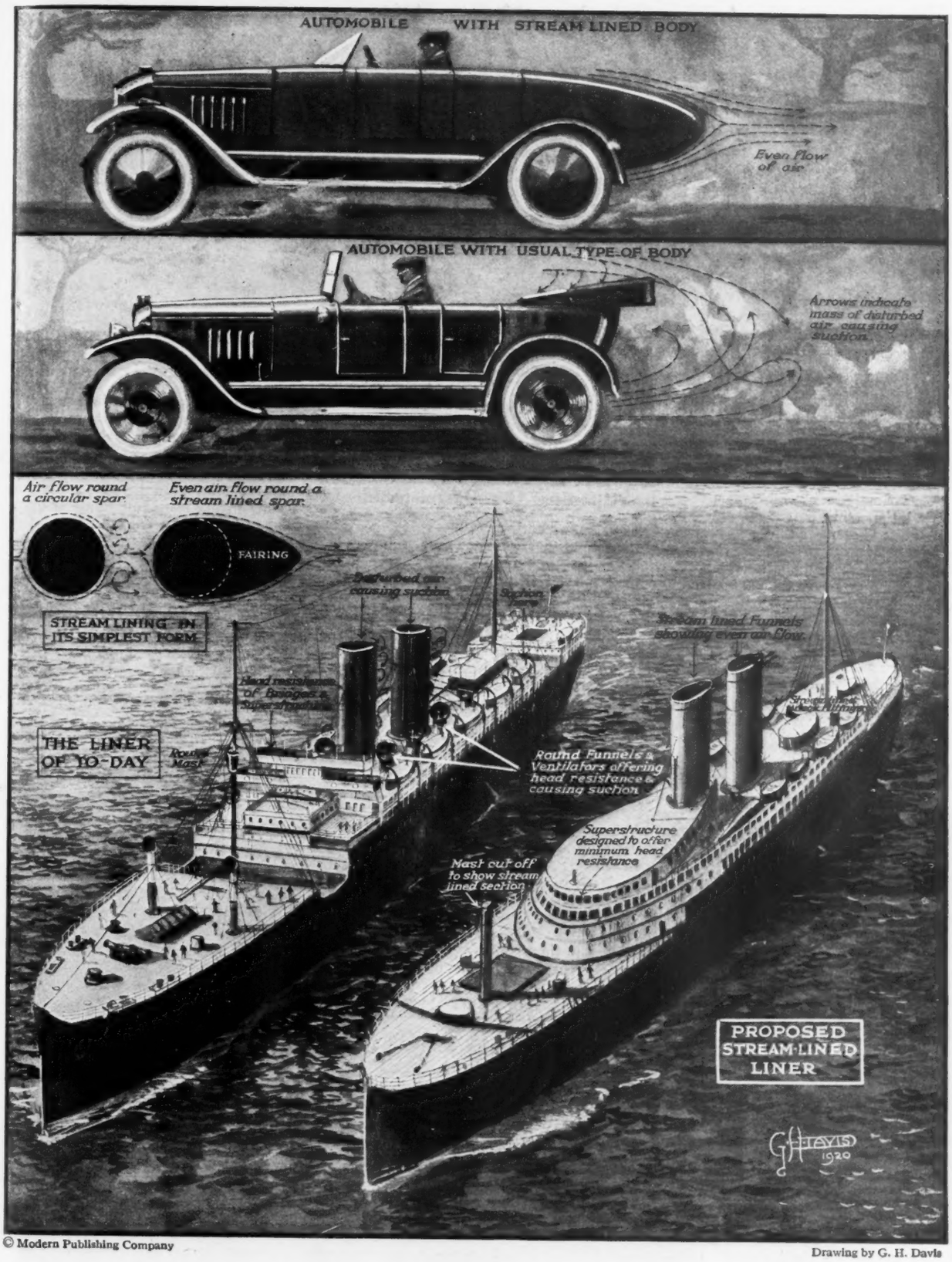
Preventing Spontaneous Combustion of Coal

SPONTANEOUS combustion often starts in the interior of a coal-pile. Long steel tubes with bulbs mounted at their lower ends reach down into the coal. The tubes and bulbs are filled with alcohol, the expansion of which moves the pointers on the dials, thus indicating the temperature.



Long steel tubes with bulbs filled with alcohol reach down into the coal-pile, registering the temperature on dials reaching above the surface of the coal




AUTOMOBILE WITH STREAM LINED BODY
Even Flow of air
AUTOMOBILE WITH USUAL TYPE OF BODY
Arrows indicate mass of disturbed air causing suction
Air flow round a circular spar
Even air flow round a stream lined spar
FAIRING
STREAM LINING IN ITS SIMPLEST FORM
Disturbed air causing suction
Suction
Stream lined Funnels showing even air flow
Head resistance of Bridges & Superstructure
THE LINER OF TO-DAY
Round Mast
Round Funnels & Ventilators offering head resistance & causing suction
Superstructure designed to offer minimum head resistance
Mast cut off to show stream lined section
PROPOSED STREAM-LINED LINER
G.H. DAVIS 1920

© Modern Publishing Company

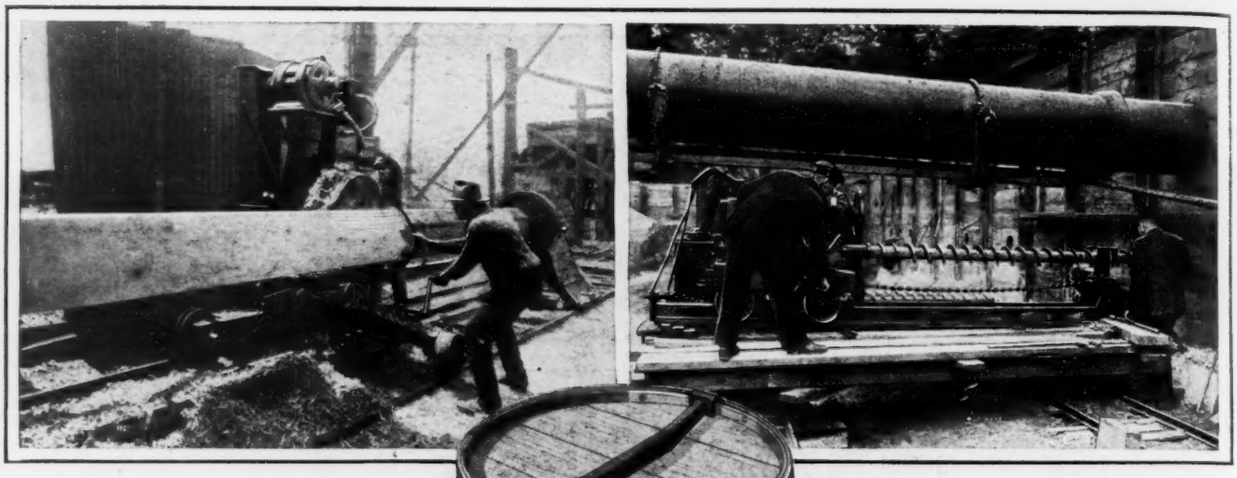
Drawing by G. H. Davis

Streamlining—How It Would Reduce Air Resistance

It is not generally known that even perfectly still air opposes any moving vehicle to a degree equaling that of a wind of the vehicle's speed. Thus a vehicle traveling at thirty miles an hour against a headwind of thirty miles really encounters a sixty-mile gale.

Streamlining came into prominence with the enormous speeds attained by aircraft, and it was later proposed for railroad trains. The latest application of the principle is to steamships and automobiles.

In the drawing, the eddying effect of a headwind is indicated by arrows. The streamlined ocean-liner has a strange appearance—even the funnels and masts being changed. It is to be hoped that some progressive shipping company will soon give the idea a serious test



Turning Up a Mast in Three Hours

NOWADAYS a machine like this can turn out a hundred-foot mast in three hours, when it used to take a man one week to do such a job.

A rotating cutter comes in contact with the rough mast as it revolves between the centers of a lathe. The cutter is mounted on a small truck or carriage that rolls along a railroad track.

Both the headstock and the tailstock of the lathe are made adjustable along the track to accommodate logs of different length. When the cutter starts to revolve, chips fly in every direction.

Stiffening the Barrel-Head

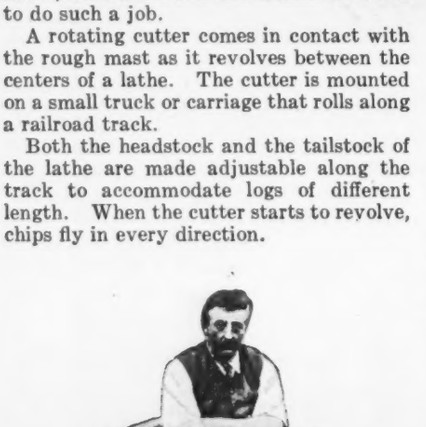
THE manufacturer who ships heavy wares in barrels can save time and money by making use of a specially designed cleat that fits the head of the barrel.

The cleat is placed in position with the flat end driven downward between the hoop and stave. A nail is then driven through the hoop and cleat. A truss runs across the barrel-top, ties the two cleats, and stiffens the barrel against the strain of whatever heavy weight it may contain.

No Rest for This Auger

HERE is a huge auger that once had a war-time use. It was employed by German army engineers in mining operations. Today it is used to bore holes in the construction of tunnels in Germany. It can also be used to put underground conduits in place without digging ditches.

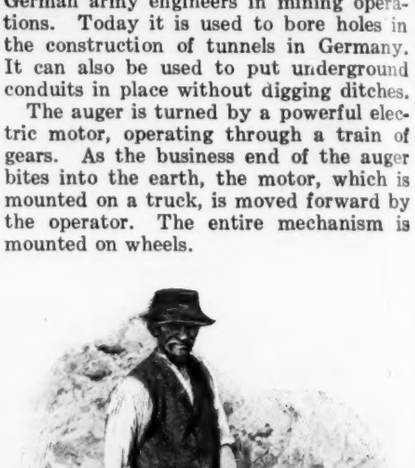
The auger is turned by a powerful electric motor, operating through a train of gears. As the business end of the auger bites into the earth, the motor, which is mounted on a truck, is moved forward by the operator. The entire mechanism is mounted on wheels.



An Eighty-Year-Old Water-Wheel

A HUGE water-wheel, sixty feet high, has been in existence at Troy, New York, for the past eighty years.

In the first fifty years of its life it worked for a large manufacturing plant, developing as much as twelve hundred horsepower. But at the age of fifty it was retired—due to its old-fashioned way. Since then it has done nothing but act as a landmark which all visitors to Troy should see.



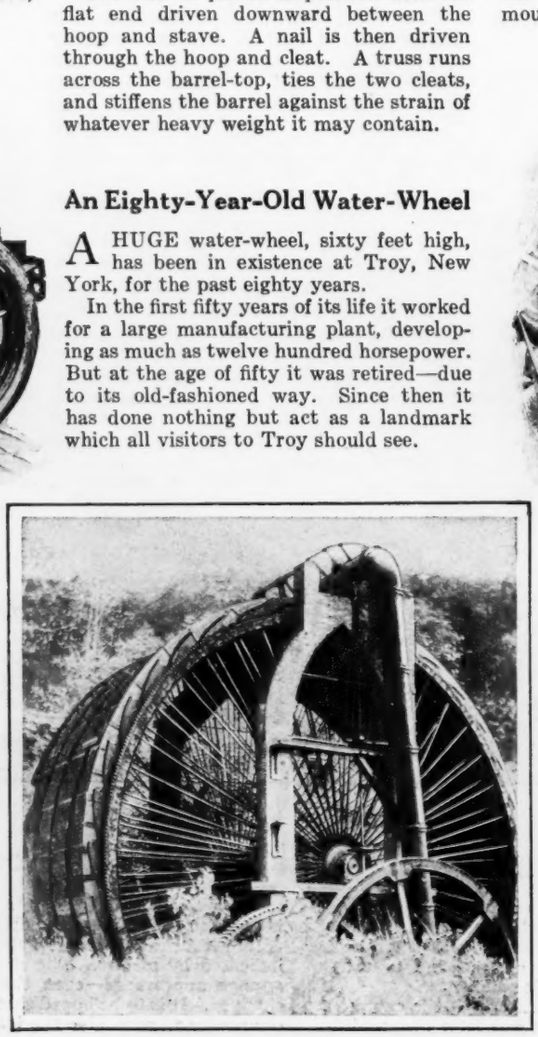
© Keystone View Company

To Stop the Automobile

IF you are driving along at a brisk rate and your automobile strikes an obstinate pedestrian, here is a device that automatically prevents the car from running entirely over the unfortunate victim.

Two iron shoes, projecting in front of the rear wheels, at the touch of an obstacle on the push-bar are released. This causes the rear wheels to be mounted upward, thus causing the car to stop, more or less gracefully—depending upon the speed at which it is going.

The invention has been satisfactorily tested. If the automobile were coming full speed down a hill when the rear wheels were suddenly elevated, one might expect the machine to "nose over."



Iron as a Rubber Substitute

GERMANY has been starving for rubber ever since the early days of the war. The little rubber in the country is put to use only in cases of absolute necessity. In fact, it is so expensive that it cannot be used except where it is badly needed.

The man in the picture is forced to wear boots hammered into shape from galvanized iron. The joints are soldered and the boots are perfectly water-tight. They enable him to work without getting his feet wet, but, from the looks of them, they must be very clumsy when he attempts to walk in them.

Sheet iron is also a poor heat insulator, and such boots would be very cold in the winter-time.

The Kind of Shoes that Miners Wear

LOOK at the complicated and expensive rubber shoe the miner must wear if he wishes absolute comfort and safety while he works.

The shoe is in one piece; it hasn't even a flap up the front. The top of the shoe is close-fitting, and is provided with an outside lace that will draw the top together if the wearer happens to have very thin legs. Thus dust and dirt cannot enter to irritate the foot.

The shoe is lined with flexible net that prevents chafing.

A double sole runs the full length of the shoe; the bottom side of the sole portion is roughened to prevent slipping on the floor of the mine-shaft.

For Greater Gas-Burner Efficiency

WHAT is the efficiency of the gas-burner in your home? This should interest you, as you have to pay the gas-bills.

Below you see a physicist in the Bureau of Standards trying to determine the actual heating value of a certain amount of gas supplied to a certain type of burner. The physicist determines the heating value of gas in the number of British thermal units that a certain amount of it gives off during the process of combustion.

The burner is enclosed in the tank shown, which is provided with various heat-measuring instruments. The gas consumed by the burner is measured with the gas-meter.

One Man Can Load Logs with This Apparatus

IN the picture above is shown a new apparatus by which one man can load heavy logs. The two inclines have pegs that fall in one direction only.

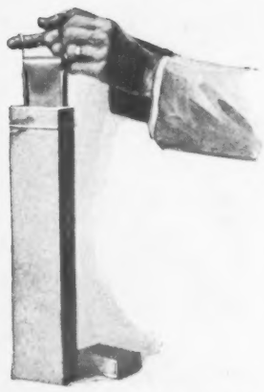
When a log is rolled over them, the pegs fall, but are pulled back by a spring into a vertical position after the log has passed. In this way the log is prevented from rolling down the incline, and if it is a very heavy one, the workman may rest during his task.

This apparatus can be folded.

Economizing on Coal

HERE are several ways to save coal: Experiment with different kinds and mixtures until the best is found for your heater.

Do not poke the fire unless the coal is the kind that forms a crust to interfere with the draft. Clean out ashes each time after shaking. Insulate pipes and warm air-ducts. Keep the humidity between forty and fifty per cent, for moist air heats more quickly and is much more healthful.



A New Film and Plate Developer

A NEW device has been perfected for developing films and plates. It is made of metal, and consists of a long narrow tank into which is fitted one or more holders, also made of metal.

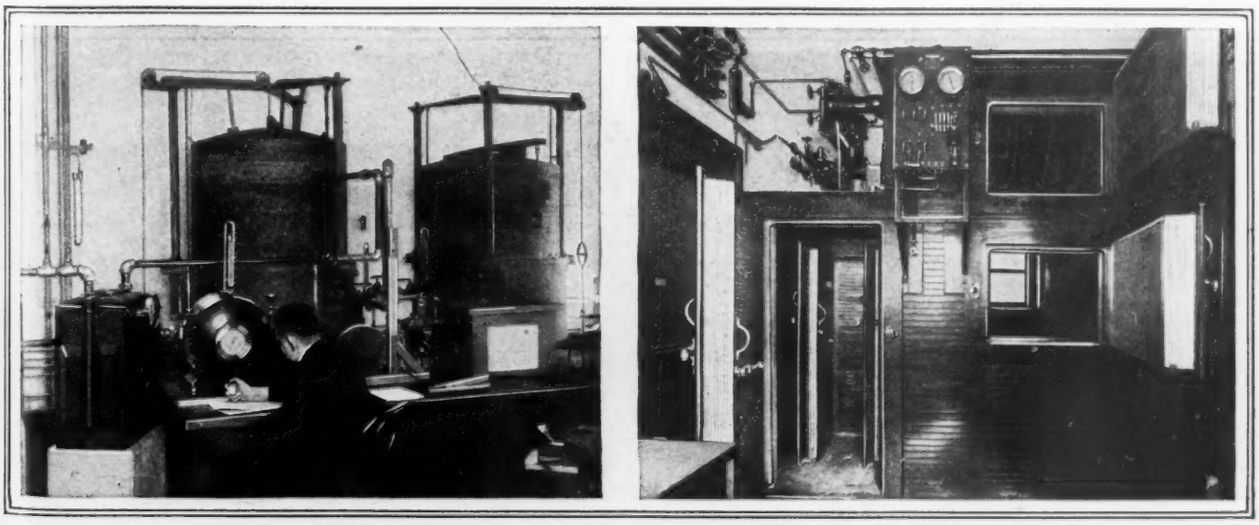
The holders have flanged sides that are adjustable and detachable. They can be fitted with an entire roll of films, or several cut films, or several glass plates.

The design of the tank is narrow, as the developing solution keeps much better in a narrow tank than in a wider one. After the negatives have been developed, it is necessary merely to remove the flanged side of the holders to release the negatives.

Batteries Put in Cold Storage

THIS room represents a refrigerating outfit designed by the National Bureau of Standards for studying primary and secondary batteries. Low-temperature electrical investigations are made by direct absorption in the absence of brine.

Temperature measurements are made with thermocouples. On the inside of the box are two panels, one for wires conveying the current and another for voltage. These are affixed to the cells being measured inside the box. In front of the observer's desk are similar panels to which the panels inside of the box are conveyed. From these panels the instruments for studying the performances of batteries are attached.



Your Lucky Number in a Ring

WHAT'S happened to the many pairs of dice that used to jingle at the bar? Some of the braver dice-owners are doing their "crap-shooting" at home now. But the weaker ones who have submitted to the anti-crap home regulations, but who would like to keep a memento of days gone by, are uncertain about the disposal of their beloved "bones."

Here's a suggestion that has been offered by a fellow shooter. Turn up the side of a dice that registers your lucky number. Then carve out the center and trim down the other sides until your dice becomes an emblem to be set in a ring like the one shown in the illustration above, where it serves as a little-finger ring in place of the more usual seal ring.

Chess Is One of Their Studies

IT'S easier to learn when you're young than when you've grown up, so we have always been told. Take the game of chess, for instance. It is one of the best brain-exercisers there is, and yet the champion player is a very young boy, who has beaten chess-players of many nations.

The game is a compulsory subject in the school of the village of Strobeck, Germany.

The children must pass examinations in chess, just as they are compelled to in any other subject in the school's curriculum.

In the picture you see a class of children on their way to school. As you see, each child carries his or her chessboard.

These Men Are Not Snake-Eaters

TO be an efficient snake-charmer, you must really love creeping things, and be willing to let them crawl all over you. Take, for example, the two African snake-charmers shown above. Not only are their pet snakes wound around their necks, but they have their snakes' heads in their mouths!

The snakes are of the poisonous class, and yet they do not harm their masters. Charm—that's what it's called; but in reality how can the snakes bite when their jaws are firmly held together?

Certain kinds of music will make snakes sway from side to side. Snake-charmers of India, for instance, have exhibited remarkable control over snakes through this medium.

A Bad Case of Overpopulation

SOME of our large cities—New York and Chicago—are overpopulated; but compare them with the island of Ukara in Lake Victoria Nyanza, Africa. It has an area of thirty-six square miles and has a population of nineteen thousand. A man must not touch his neighbor's leaves, sticks, or rubbish. Garden plots are carefully marked off, and trees are so scarce that a father often divides a tree among his family, giving certain branches to each member.

An Effective Pocket Pipe-Scraper

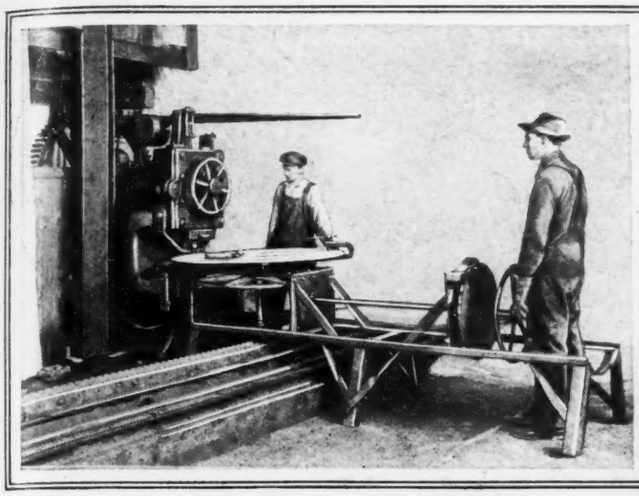
AND of making many pipe-cleaners there is no end. There are almost as many kinds of pipe-cleaners as there are of pipes. Some of these cleaners steam out the disagreeable "cake," others remove it by chemicals, and still others scrape it out.

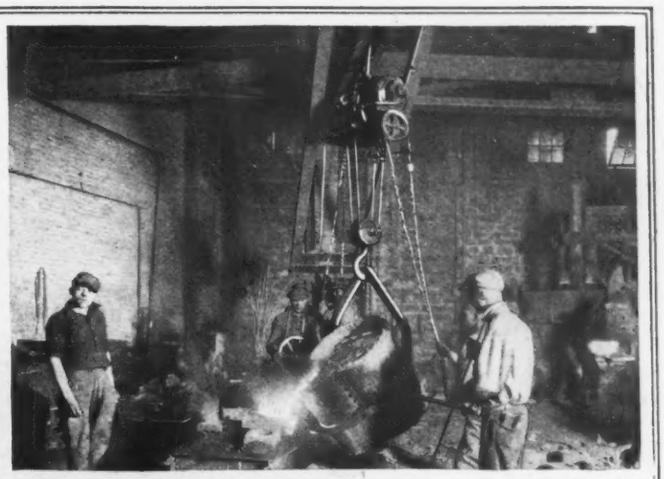
The pipe-cleaner above belongs to the scraping class. It consists of a curved handle having two projecting arms. Attached to these arms are two metal blades. The blades have spring attachments that make the blades fit snugly inside any pipe-bowl, regardless of its size. A quick twist of the handle will efficiently remove the "cake," and after the pipe has been thoroughly scraped, the scraper is cleaned and put aside until it is again needed.

Running a Pullman on Tires

HERE is a new French Pullman car mounted on rubber-tired wheels. It is to be "pulled" over the battlefields of France by an automobile. Complete accommodation is provided for this luxurious car. A wash-room, beds, and luncheon-tables are carried. It is suspended on heavy springs, and these will allow it to travel over bad roads and fields with as little discomfort as possible to the occupants of the car.

The big car is shown here, ready to start on its journey. Who is going to travel in it? We confess that we don't know. It certainly must be somebody with plenty of money who can afford such a luxury as this in these days.

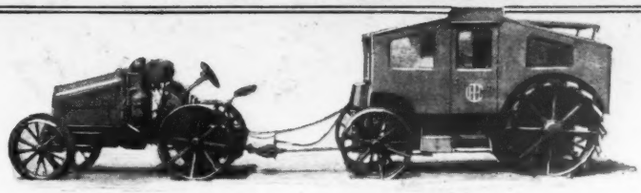




Punching 30,000 Holes a Day

THE punching of thirty thousand holes in steel plate tank heads is only a day's work for this machine. An ordinary punch-press is used with a special attachment that turns the heavy plate disk every time a hole is punched.

Two men operate the press. One trips the punch-press and the other manipulates the device that turns the plate. A horizontal shaft has a notched disk mounted on it. A pawl engages the notches, and as a hole is punched, the operator turns the horizontal shaft, which is connected by bevel gears to the vertical shaft carrying the steel disk to be punched. This turns the steel disk a fixed distance each time.



To Test the Tractor's Pull

IN the picture above is shown a steel car trailing after the tractor. This car contains a dynamometer (an instrument somewhat like a spring scale) that measures the pull of the tractor. The power of the tractor when driving farm machinery by a belt can be measured by belting the tractor engine to the dynamometer.

This testing apparatus was constructed by a large tractor manufacturer so that tractors could be tested under actual working conditions, which is much better than merely testing the engine upon a block in the factory.

Hot Metal Handled by Electric Crane

HANDLING molten metal in foundries has always been a problem. Accidents occur frequently when the crucibles are carried about by hand. A man stumbles, falls, and there is a hurry-up call for the ambulance.

This little electric crane helps to eliminate accidents and adds greatly to the efficiency of the foundry, since it can carry heavy loads. The man controls the movement of the crane by a chain. Pulling the chain in one direction operates the motor, and pulling it in the opposite direction stops the motor. The crane runs along a monorail from the mouth of the furnace to the molds. The hoist illustrated can lift three tons.

Pliers for Shortening Chains

CRACK! For the twentieth time you bump your head against the chandelier. And you will continue to bump it unless you shorten its chain. To shorten it you must remove some of the links.

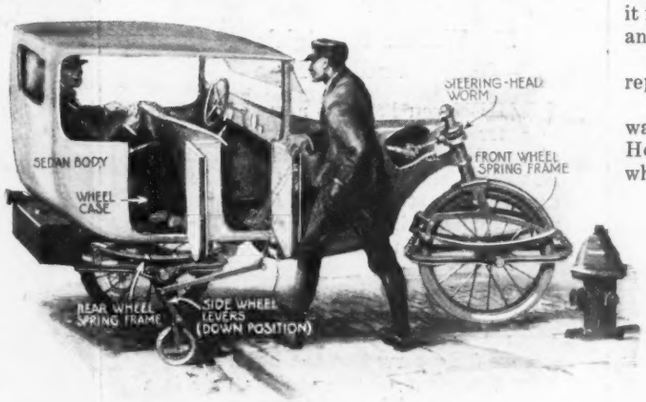
This can be done with the peculiar pliers shown. The handles are notched on the inside and the jaws are notched on the outside.

The outside notches are used for opening. You slip the undesired link over the notches and press the handles together. This causes the jaws to spread, and as a result the link, which is firmly held, also will spread. To close a link, you squeeze it between the notches in the handle.

A Two-Wheeled Automobile

SHOULD your automobile run on two wheels, your tire expenses would be cut in half. But how can an automobile run on two wheels? Mr. Andrew Duresen, of Minneapolis, is able to answer that question, for he has recently patented a two-wheeled motor-vehicle.

The two wheels are large ones and are on the center line of the chassis—one at the front, the other at the rear. Two small auxiliary wheels are located on either side of the rear one and they are used in stopping and starting to maintain balance. However, after the automobile has gained sufficient speed, the small wheels are raised from the ground by a lever and balance is maintained because of the speed.



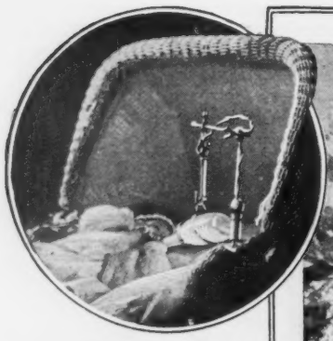
Lightning Made to Order

A BLINDING flash is followed by a harsh crackling sound. Lightning has struck the tall pine, splitting it in two. One half falls on the villain and the other half bursts into flames.

Exciting, isn't it? But how can it be reproduced in the movies?

Allan Dwan, a well-known producer, was confronted with this problem. He referred it to his technical staff, who spent many weeks and dollars in study and experimentation.

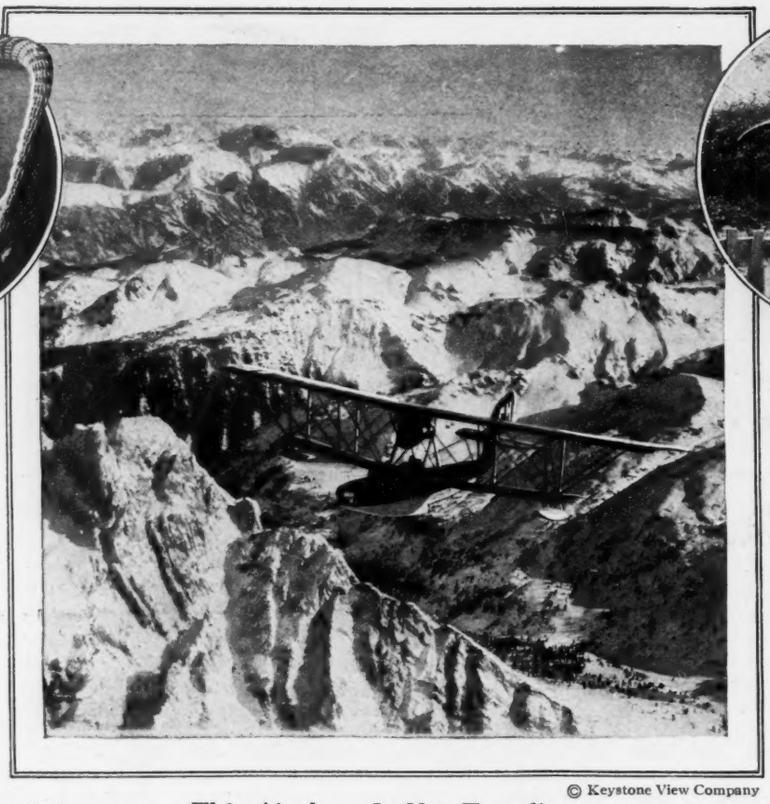
Here's how Mr. Dwan himself solved the problem: He took a strip of unused film, fastened it to the window-pane, and with the point of a glass thumb-tack scratched on it several branching lightning bolts. An artificial tree was flashed on the scratched film.



Bell Rings When Bottle Is Empty

"HARK, the bell is ringing!" Whereupon the nurse removes the empty bottle from the hook.

Bell and hook are part of a bottle-holder invented by Charles McNeil, of Beverly, Massachusetts. The bottle is placed in a cage suspended from the hook. A spring is attached to the hook, and this pulls the hook upward gradually as the baby drinks the milk. When the bottle is entirely empty, a screw on top of the hook will touch an electric conductor, thus closing a circuit. The bell rings and the nurse removes the bottle.



© Keystone View Company

This Airplane Is Not Traveling to the North Pole

SCATTERED through the snow-covered Swiss Alps are slanting slopes possibly smooth enough to permit a flying-machine to land if it is equipped with suitable running gear. There are also lakes upon which a hydroplane could land, if they happened to be within convenient reach.

The modern airplane engine has become such a reliable factor of safety that little danger from motor trouble is to be feared, when the mechanism is in good condition at the start. The intense cold and the thin air prevailing in the region of the alpine summits throws a strain upon the engine, which it must be specially designed to withstand.

The Old Oaken Fence Python

IF you've never seen a python, and never hope to see one, take a long, careful look at the picture above. The queer snaky creature that is resting its chin on the fence is the dead image of a python ready to spring at its unsuspecting prey. Why dead? Because it is an old gnarled limb of an oak-tree.

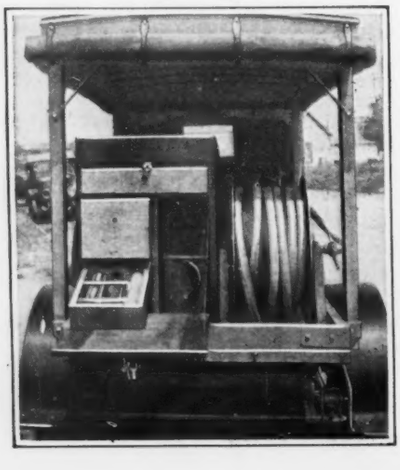
Except for the eyes and the mouth, the oak python has not been changed. It was cut down forty years ago, and since then has decorated the fence, which is located in Seers Green, Buckinghamshire, England.

A Laboratory on Wheels

APPARATUS on this truck is used to test natural gas as it comes from the wells, to determine its gasoline content.

Before gas from new wells is piped to a plant, its gasoline content is determined, to make sure that the quantity of the gasoline per thousand cubic feet of gas will make it profitable to run it through the plant. Then, too, gas from wells already piped through plants is tested by this truck-compressor unit as a check.

Attached to a reel on the right side of the truck is a rubber hose to reach from the truck to the gas line. Passing through a meter, the gas is measured. Then it goes through the compressor, into a condenser, accumulating in a cylinder that extends below the trunk body. A gage-glass shows the cubic centimeters of gasoline.



Sir Walter Raleigh's Indian Pipe

WHEN you hear the name of Sir Walter Raleigh, you immediately think of a puddle, a coat, and Queen Elizabeth. But Sir Walter did many things besides casting his coat in the mud for a queen to walk on. For instance, he helped in the work of colonizing America.

He made friends with the Indians, and as a result they presented him with the strange pipe shown above. It is made of Virginia maple-wood, and has many strange faces carved on the bowl.

In the stem of this curious pipe is a whistle with which Sir Walter summoned his servants.

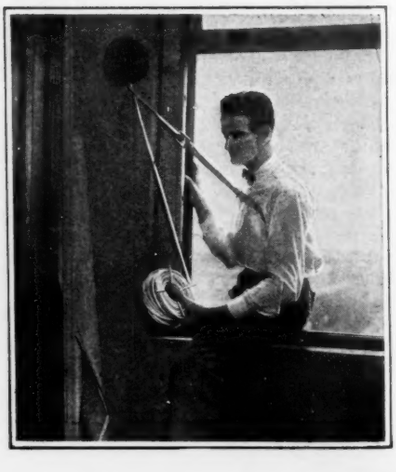
An Individual Fire-Escape

PERSONS sleeping in hotel rooms with one of these little fire-escapes located near the window can feel perfectly safe, since, in the event of fire, it will lower them to the street below with no danger of accident.

A man of average weight will drop about four yards a second until his feet rest on the street.

A retarding device attached prevents the rope from passing through beyond a certain speed. The rope has a steel wire running through its center, and this is capable of sustaining a weight of eleven hundred pounds.

The man seen in the picture below is shown ready to drop out of an eight-story window, and he does not look a bit frightened.



How the Trombonist Watches the Play

HE plays the trombone in a theater. He sits beneath the stage, and, what is more, he faces the audience. He can't see the play. At the end of the crook of his long trombone he fixes a mirror. Thus he sees the stage, not because he is interested in the play, but because he must give a blast from his instrument at the right moment to suit some action or word on the stage.

Every one is familiar with the mirror used by the organist in a church, tilted so that he can see the reflection of the congregation and can get his cue when to play.

The simple idea of "looking around a corner" has been developed into the "periscope." In some periscopes lenses and diagonal reflecting prisms are used instead of mirrors. A lens at the upper end of the tube brings the rays of light upon a reflecting surface at an angle of forty-five degrees to the axis of the tube and these rays are brought to a point at the bottom of the tube after a second reflection from the back of a prism. In other periscopes only two mirrors and no lenses are used.

Every automobilist is familiar with the principle pressed into service by this ingenious musician. A little adjustable mirror is often used on the wind-shield to see cars approaching in the rear.

Mirrors have been used over windows and doors to give the occupants of a room a view of the street. Instead of having to go to the window and lean out to see who is at the front door, all the housewife has to do is to look up at the mirror. It is tilted at an angle suitable for throwing the reflection into a convenient location.

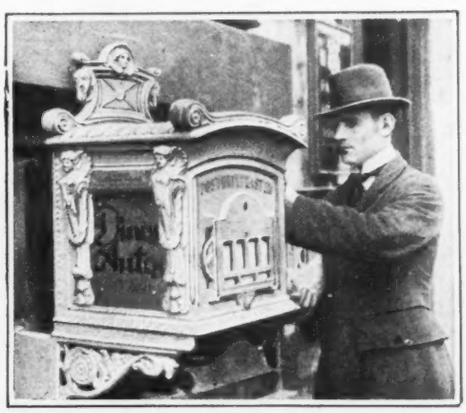
Advertising Space Rented on Mail-Boxes

THE people in some of the countries across the seas are hard pressed to raise money to pay their national debt. To levy taxes on the rank and file of the populace is to work new hardships that have already reached a limit of endurance.

Thus it is that the government of Germany has decided to sell advertising space on mail-boxes and other government property.

How many mail-boxes are there in the United States? Think of the number in your own town, the number on your own street. Of course they are better looking painted in neutral or plain colors; but if funds have to be raised to satisfy official desires and public necessity, selling advertising space is better than taxing the people.

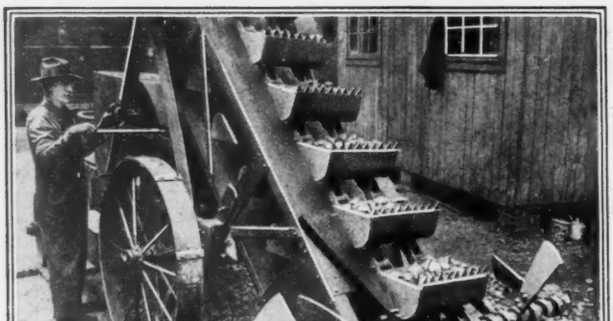
Advertisements of a uniform character, ornamentally considered and artistically designed, would not spoil Uncle Sam's mail-boxes. Besides, they would save the expense of paint.



Find Your Own Seat in the Theater

CAN a theater do without ushers? Several theaters in Vienna have managed it by placing an electric light on each seat. When the seat is empty, the light flares up and illuminates the number on the seat. But when the seat is occupied, the light, becoming disconnected, disappears.

If you arrive after the play has started and the theater is dark, it will be a simple matter for you to find your illuminated seat. Then, too, you will not annoy the people who are already seated and are interested in the play. If an usher guides you, she must tell you where your seats are and perhaps flash a light on them, greatly disturbing the people who arrived before the lights went out.



A "path-digging" machine that cuts its way into a coal-pile, loading a ton of coal a minute

Digging through the Coal

NO man can dig a ton of coal and load it into a wagon each minute of the working day. But it is possible for one man to make a machine do this work for him, and that at the low cost of half a cent a ton. Wagon-loaders have been in operation for a long time; but the device that uses propeller blades to break into the pile of coal or crushed stone to be loaded into a wagon or passed upon a conveyor is indeed a wonderful labor-saving machine.

A man at best can shovel but two tons an hour; with the machine he can shovel about sixty tons in that time. If he earns five dollars a day, the cost of moving the sixteen tons of coal he would handle in a working day amounts to thirty-one cents a ton. This is large compared with the machine handling of the same amount for about one and one-half cents—which includes both labor and power.

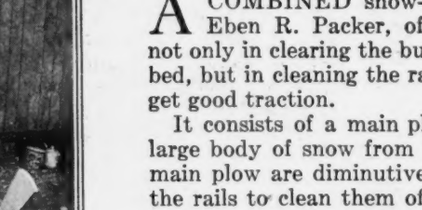
Crushed stone, sand, gravel, coal (both hard and soft), can be dug up and discharged into a truck, all in one operation. No longer are human shovelers needed to work in the sun or the drizzling weather to clear a pathway for the back wheels of the wagon-loader in order that the "elevator buckets" can reach more material.

Little Plows Make a Big One

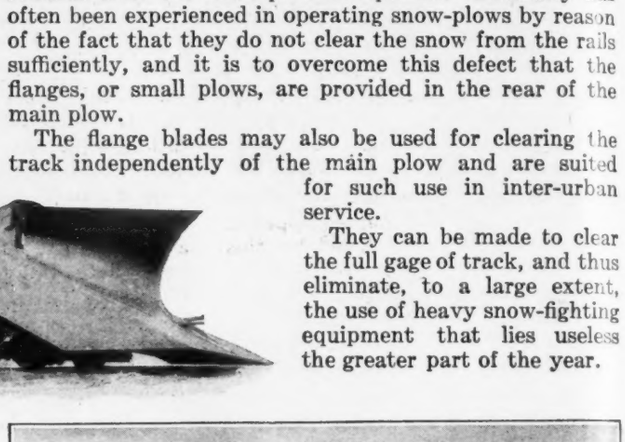
A COMBINED snow-plow and flanger, invented by Eben R. Packer, of Wilmette, Illinois, is effective not only in clearing the bulk of snow from a railroad road-bed, but in cleaning the rails sufficiently for the wheels to get good traction.

It consists of a main plow, adapted to clear away the large body of snow from the track, and rearward of this main plow are diminutive plows that are spaced close to the rails to clean them off if any small quantity of snow remains after the main plow has passed. Difficulty has often been experienced in operating snow-plows by reason of the fact that they do not clear the snow from the rails sufficiently, and it is to overcome this defect that the flanges, or small plows, are provided in the rear of the main plow.

The flange blades may also be used for clearing the track independently of the main plow and are suited for such use in inter-urban service.



They can be made to clear the full gage of track, and thus eliminate, to a large extent, the use of heavy snow-fighting equipment that lies useless the greater part of the year.

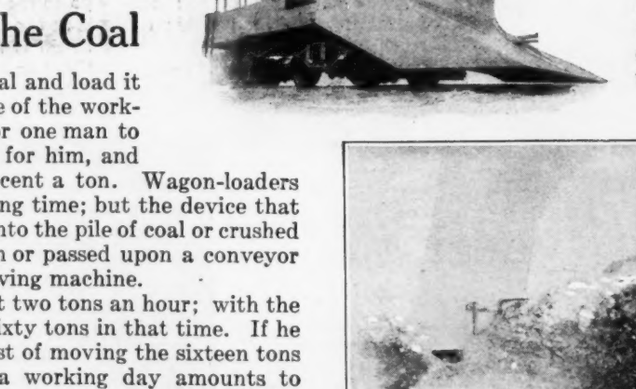


Whirling the snow before it in a huge cloud, this new plow makes short work of clearing railroad tracks

Scrubbing Floors with a Hand Machine

SCRUBBING and mopping floors is one of the most disagreeable tasks for houseworkers. The apparatus illustrated is a German invention, and in some respects it resembles some of the numerous mopping devices used in America.

Attached to a long handle are two folding wings of metal. One of the wings is rigidly attached to one end of the handle, while the other wing may be opened like the cover of a book or closed almost in contact with the fixed wing by means of wire rods held in place by a clip. Fastened to the outer side of the movable wing is a stiff brush, which is immersed in soapy water and used for scrubbing. After a certain portion of the floor has been scrubbed, the wings of the hook-like holder are opened and a cushion or bag filled with sponge is inserted and fastened between the wings by closing and clamping them. This cushion, the edge of which extends beyond the wings, is soaked thoroughly in soapy water, pressed out, and then used for mopping the scrubbed part of the floor. Neither the brush nor the mop need ever be handled by the operator.



The scrubbing-cloth is held firmly between two metal wings; the device is easily manipulated by means of the long handle

Getting ready for the usually unpleasant task of scrubbing the kitchen floor. The mopping-cushion contains a sponge

When the mopping-cushion becomes muddy from use, it is rinsed out in clean water and soaped over again to tackle a new area of floor

Collecting Fish for the Aquarium

VISITORS to wonderful city aquariums, like that one in old Castle Garden, where in the early days Jenny Lind charmed New Yorkers, seldom stop to consider that the strange and beautiful specimens behind the glass walls did not originate there.

How does a public aquarium get its fish? As a rule the dealers in live fish sell only goldfish, alligators, and sea-lions, so that when a variety is desired for the collection of an aquarium, it is necessary to send out an expedition to get the kinds of specimens that are wanted.

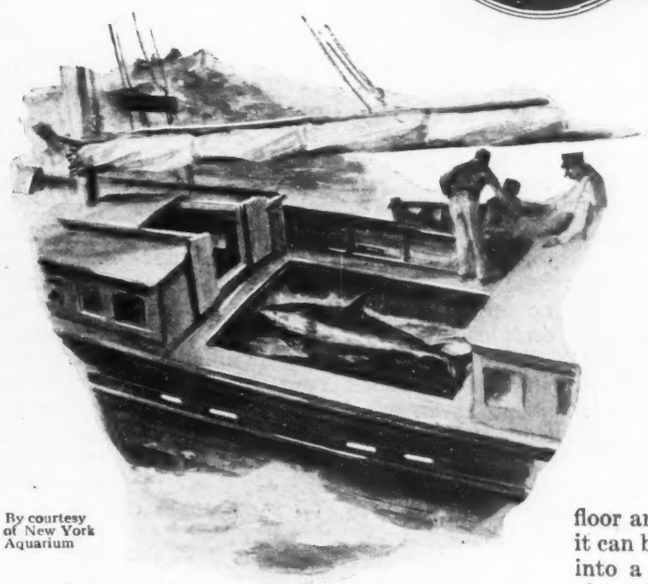
For this purpose Dr. Charles H. Townsend, director of the New York Aquarium, has built and equipped a small, staunch boat designed for this particular purpose. The *Sea Horse* is a thirty-foot sloop equipped with sails that are used with favorable wind, and also a twenty-five-horsepower gasoline engine.

In the center of the boat is a tank or "well," ten feet long, seven feet deep, and three feet wide, which is filled to a depth of two and one half feet with water. It is large enough to hold a ten-foot shark, if such a specimen is desired.

On a recent three-day trip off Sandy Hook, about three hundred fish were brought back to be used in the exhibition tanks of the aquarium, where thousands of people go every week to see them.

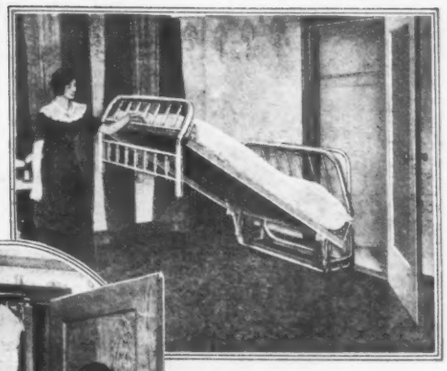
In this region of the coast there are more than two hundred and twenty-five different kinds of fishes scientifically recorded, and it is the purpose of the director of the aquarium ultimately to secure some of each. Caught in the hauls after plenty of hard work were puffers, spots or lafayettes, flounders, eels, rock-crabs big horseshoe-crabs, and sculpins.

Seine fishing took up much of the time. A trawl was also dragged on the sandy bottom for a distance. With a crew of four men the work is easily accomplished, and comfortable quarters are provided for the crew aboard when their work of the day is done. Besides being capable of carrying a shark if one is captured, the well is large enough to accommodate a five hundred-pound fish.



By courtesy of New York Aquarium

The *Sea Horse* is equipped with a well in which even a shark can live



Here is a bed that clamps the bedclothes and folds up into a compact arrangement

The bed can be put into the clothes-closet without disturbing the clothes hanging there

Living-Room and Bedroom in One

HERE is a device that makes it possible to use one room for the double purpose of a sleeping-room and living-room, and yet in the daytime not only to have all the floor space free for living-room purposes, but to have nothing about it to suggest the bedroom.

At night the room contains what is practically an ordinary metal bed, resting firmly on four feet on the floor and of full size. In the daytime it can be instantly tilted up and swung into a dress-closet of ordinary dimensions, the door may be closed, and the room, as far as the bed is concerned, will be a living-room.

The bed can be swung into a closet that is only thirty-five inches deep and in the average clothes-closet there is still room for clothing, and entrance may be gained to the closet without removing the bed. Since the bed does not hang on the door, but rests on the floor at all times, there is no strain on the joists or frame of the closet door. The bed itself does not fold, but turns up and by means of friction-clamps at the foot, the bedclothing is held in place when the bed is in the closet or recess, and the pillows are held in their place by the head frame.

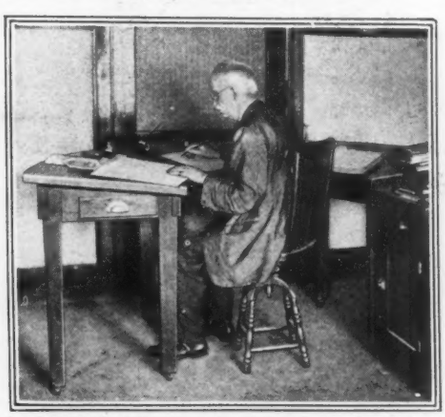
Not only does this device conserve space, but it also saves expense in furnishing, since one room does duty for two. This bed is an improvement over the old folding-bed that every one recognized for what it was.

The Time-Saving Bookkeeper's Table

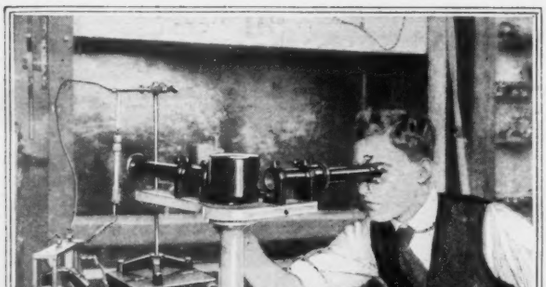
OFFICE efficiency managers, please take notice! Here is a bookkeeper's desk, invented by B. P. Beeson, of Sapulpa, Oklahoma, that will add efficiency to any accounting-office. With it a bookkeeper may keep all of his books spread out before him, and reach any one of them merely by turning his swivel-chair.

The table is built in the form of a semicircle, and the bookkeeper takes his place at the center. At one end of the table a small cabinet is placed in which may be kept the books in use.

When a long table is used, the bookkeeper must leave his seat each time to get the book he desires to use.



The bookkeeper can swing around to any one of his spread-open books



The spectroscope that identifies gases by finding the part of the visible spectrum they absorb

A small tube of the gas argon, and a semi-finished electric-light bulb that is to be filled with the same gas

Making Shoe Uppers in One Piece

BANG! Down comes a die on a huge stamping-press, and the entire top of a shoe is cut out at one stroke.

The shape of the piece of leather cut for the "upper" of the shoe is shown at the left of the picture. It will be seen that when it is bent double, this forms the crude shape of a finished shoe. The average shoe contains three pieces of leather.

Much of the labor put in on the manufacture of the shoe has to do with the sewing together of these pieces. The new method of producing shoe uppers not only produces a more rugged shoe, but it also brings down the price. Sewn seams in shoes are apt to rip.

A shoe with an "upper" made of one piece of leather. The shape of the single piece of leather is shown in the insert. A more rugged and cheaper shoe results

The shoe with the single-piece upper has but one sewn seam. This runs up the back, where the two ends of the leather piece meet when it is doubled. It will be seen from the insert that it is not even necessary to sew in the tongue of the shoe.

How Precious Gases Reduce Light Bills

ABOUT one per cent of the air every man breathes is composed of the "noble gases," and the other ninety-nine per cent of nitrogen, hydrogen, carbon dioxide, and oxygen.

For respiratory purposes there is little need for anybody bothering much about the aristocratic gases, argon, neon, helium, krypton, and xenon, for every one of these elements is so absolutely inert that no matter how much it may be petted or abused by scientists with instruments of experimentation, it shows not a sign of response. They are all chemically inactive.

The rarity of these gases is another basis for their claim to nobility. Argon, by far the most prevalent, forms about ninety-four hundredths of one per cent of the air. Of neon there is but one part in 55,000 by volume in the air; helium, one in 185,000; krypton, one in 20,000,000; xenon, one in 170,000,000. If a man were existing on xenon alone, it would take him twenty-one hundred years to get an ordinary breath.

The one member of the gas nobility that is earning its living is argon. Argon has been found to be excellent for filling incandescent lamps of certain sizes. It increases the efficiency of the lamp and lengthens the life of the filament because it can be said that argon saves the people of the United States more than fifty million dollars a year on their electric-light bill.

As for helium, everybody realizes its peculiar value for the inflation of dirigible gasbags. Its absolute inertness makes it non-inflammable, hence no enemy bullet could explode aircraft of that type.

Before the war we had distilling apparatus which took it out of the air for about seventeen hundred dollars a cubic foot, but it can be collected very much more cheaply today. But even at ten cents a cubic foot, it would cost $300,000 to fill a first-class dirigible.

A use has been found for neon, whose only claim to commercial distinction is that when a current of electricity is passed through a tube of it, a beautiful orange-pink glow is given off.

Driving a Boat Like an Airplane

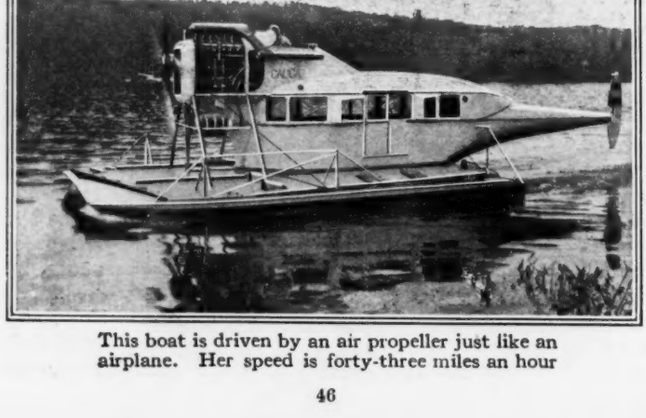
FORTY-THREE miles an hour is the speed of this gliding boat. A powerful airplane motor mounted on a pontoon with a streamline cabin makes up this craft, which has been designed for passenger-carrying service along the shallow rivers of French colonies. Ten passengers can be seated in the cabin.

The usual cruising speed of the boat is thirty-seven miles an hour with a full load. It carries enough fuel to travel for four hours, in which time it can cover a distance of 148 miles.

The pilot sits back of the twelve-cylinder aviation motor, where he controls the entire movement of the boat. When he wishes to turn the craft, he manipulates two rudders, one acting on the air and the other on the water. The air rudder is similar to the rudders used on airplanes. The pilot sits in a cockpit, protected from the terrific air-currents.

Two radiators keep the motor cool. These are made up of two concentric collectors united by a large number of thin copper radiating fins through which the water passes. A radiator of this type, with one gallon of water, has a radiating surface of 710 square inches.

The pontoon is constructed like the very latest hydroplane racing-boats. The bottom is made in an inverted V shape, which tapers off as it approaches the rear.



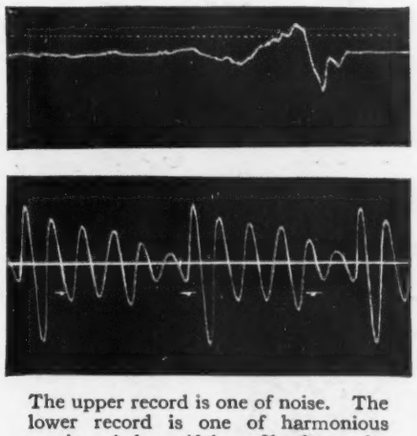
This boat is driven by an air propeller just like an airplane. Her speed is forty-three miles an hour

Making Sound-Waves Draw Pictures

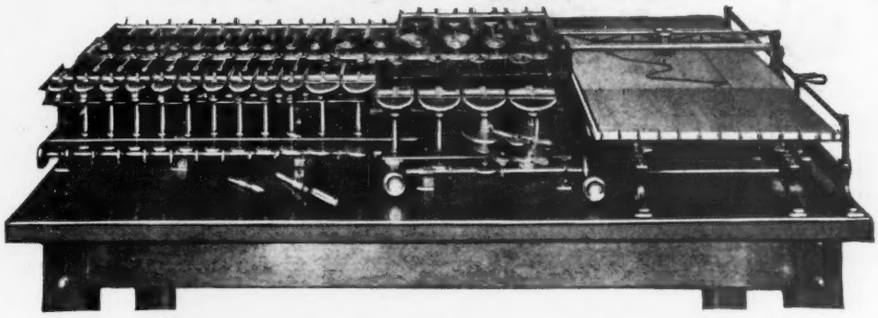
CAN you imagine the profile of a beautiful woman translated into delightful organ music? Harmonious sound, when analyzed, will also trace beautiful profiles with amazing accuracy. There is nothing poetic or sentimental about the work of Dr. Dayton C. Miller, of the Case School of Applied Science, who discovered this almost unbelievable similarity between the charm of physical beauty and the beauty of sound. It is a scientific reality.

Back in the physics class at school, we all experimented with the manometric flame that rendered sound-waves visible by causing fluctuations in the flame. By watching the flame in a revolving mirror, the vibratory effect of the sound-waves impinging upon the diaphragm used in connection with the flame can be seen.

Dr. Miller has developed a harmonic synthesizer which analyzes sound-waves and draws the resultant curves on a sheet of paper.



The upper record is one of noise. The lower record is one of harmonious music. A beautiful profile drawn by sound-waves is shown at the right



The harmonic synthesizer resolves sound-waves into their harmonic components. Each of the thirty-two elements of the machine is tuned to a certain frequency

If the sound-wave represents noise, the curve drawn will be unsymmetrical and ugly. If certain chords of music are analyzed, the profile of a beautiful face will be traced as if by magic. Any profile is reproducible by compounding a number of simple curves representing harmonic music. The synthesizer has thirty-two elements, each tuned to represent simple harmonic components.

Can the profile of any face be translated into music? To be sure—profiles may be translated into either music or noise. Your face represents either harmony or a discord. The faces of some people would create a terrible "noise" if they were translated into music. Other people would have, "low, melodious faces, full of harmony." Next time you look in the glass, see which kind you have.

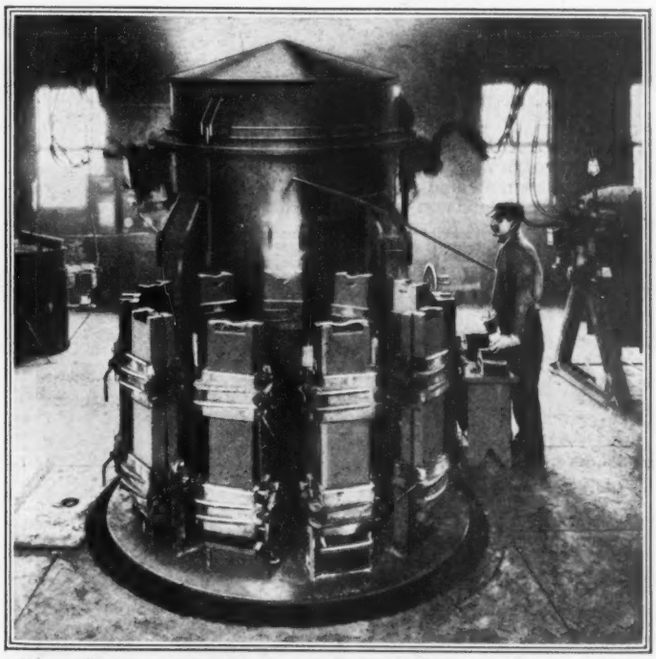
Metal Poured without a Ladle

UNTIL this device was perfected, it was necessary to bring hot metal to the molds for pouring. With this new arrangement the molds are brought to the furnace and poured.

According to common custom, the molten metal is tapped from the furnace into a ladle, which is then transported to the molding or casting floor, while the metal is allowed to run into each mold from the ladle. The contrivance illustrated is a radical departure from this old practice. The furnace itself is an electric one.

In the foreground is a revolving table on which stand several molds. Each mold is made to assume a position directly in front of the pouring spout, and a gentle tilting of the furnace causes the metal to flow directly into the molds, one at a time and successively.

The man at the right not only controls electrically the motion of the revolving table, but also opens and closes the tap-hole of the furnace, regulating the flow of the metal into the molds.



The molds are mounted on a rotating table. This has the advantage of continuous operation. The table is provided with eleven molds. Production is greatly increased through the use of this device

How Fireflies Make Their Light

IF we could manufacture light on a plan as economical as that of the firefly, the glow-worm, and other living "light-makers," our illuminating problems would be solved.

Professor E. Newton Harvey, of Princeton University, has devoted much time to the study of animal luminescence. He finds that this brand of "light-making" is similar in one way to our own methods.

A candle, a match, or any other substance that burns, does so only in the presence of oxygen. This element is also necessary for the production of light by the firefly. But it differs from our process because no carbon dioxide is given off, and because so little heat is generated. Without water the firefly cannot produce light.

The firefly's flash is actually made by a substance called luciferin. When it combines with the oxygen it becomes oxyluciferin, and after the flash is effected and the chemical combination made, the oxyluciferin is reduced in the presence of a reducing agent, becoming luciferin again. In this form it can be recombined again and again.

Dinner at the Zoo

What it means to feed the animals

Photographs © Keystone View Company

A turtle usually crawls in his shell when a man steps on his back. This turtle, however, knows his man, and he also knows that if he doesn't stretch for his food he won't get it. His food, by the way, is a large ripe banana

This is a case of Mohammed and the mountain in which the keeper plays Mohammed, and the giraffes the mountain. The giraffes did not happen to feel hungry and refused to bend their necks; the keeper, perforce, climbed the fence

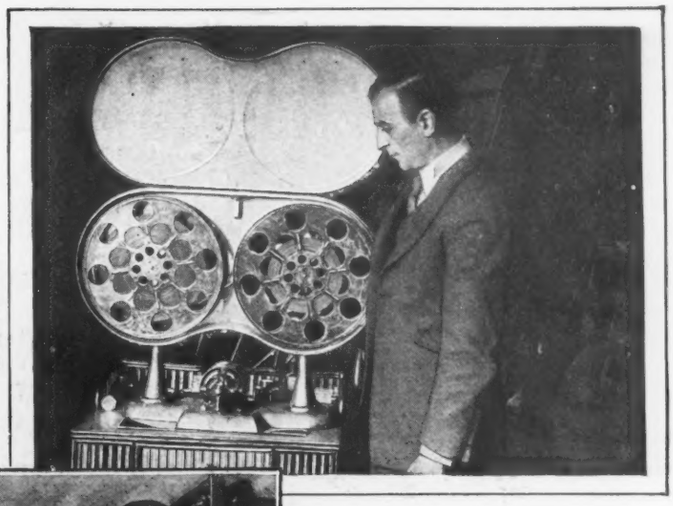
Every baby knows a bottle when it sees one; this baby is a South American woolly monkey. His nails are sharp, but he does not use them unless some one tries to take his dinner away

The boa-constrictor's dinner is very noticeable, even after he's swallowed it; it's lodged about one third the way within him. Is he suffering from indigestion? That's what the keeper is worrying about. The boa had a rat for dinner; he is particularly fond of birds and small mammals, and prefers them alive

When the hippopotamus sees the keeper approach with a pitchfork in hand, he opens his huge maw and waits. Presently a large wad of hay lands on his tongue—dinner is served

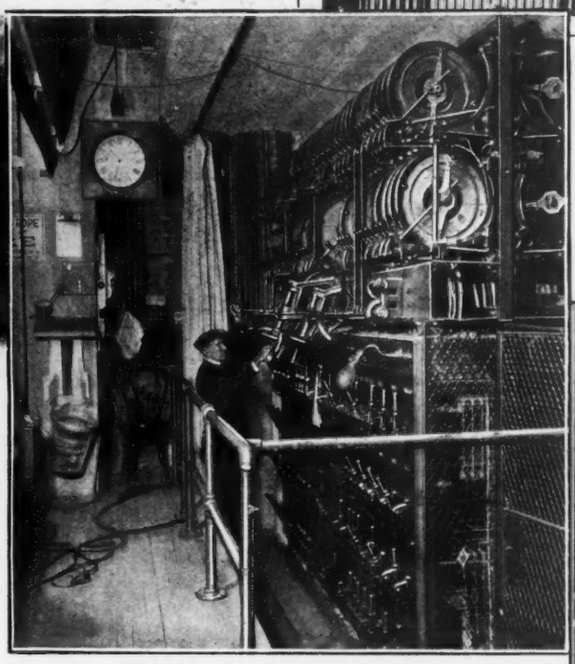
Phipps is the name of this monkey. He's about the same size as the baby woolly, although he is several months older. His dinner is fed to him by spoon—thus he learns table manners early. He was given to the New York Zoological Park by Mrs. Charlotte Donnelly, who is shown here feeding him

Lights for the Celluloid Drama



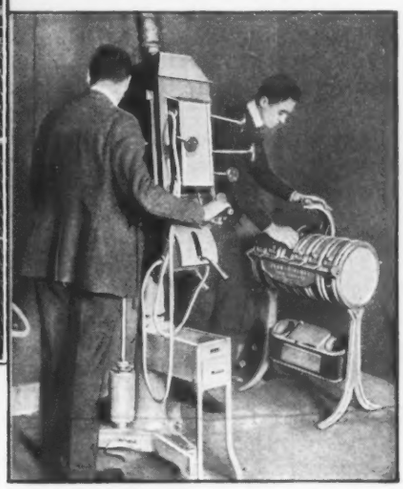
The reels in two-thousand-feet lengths are placed in automatic motor-driven winders. If anything goes wrong with the film during the winding, the mechanism automatically stops and little damage is done

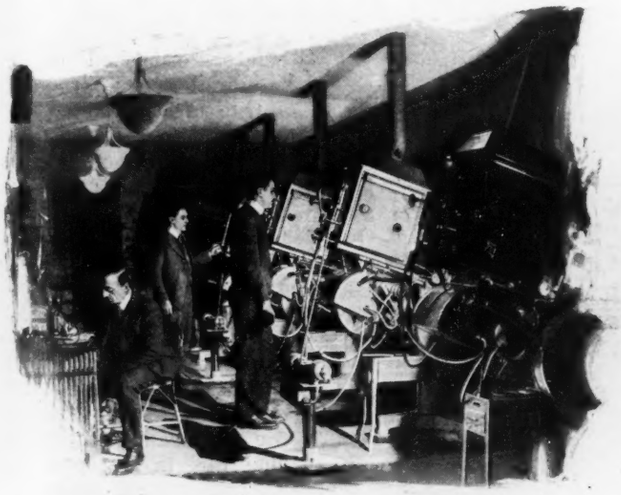
A dial indicates signals sent to the orchestra, motion-picture operator, and electrician by the director. There is also a film speed-indicator that the orchestra leader follows to time his music. Such signals as Ready; Go; Stop; Spotlight; Focus Orchestra, etc., are read



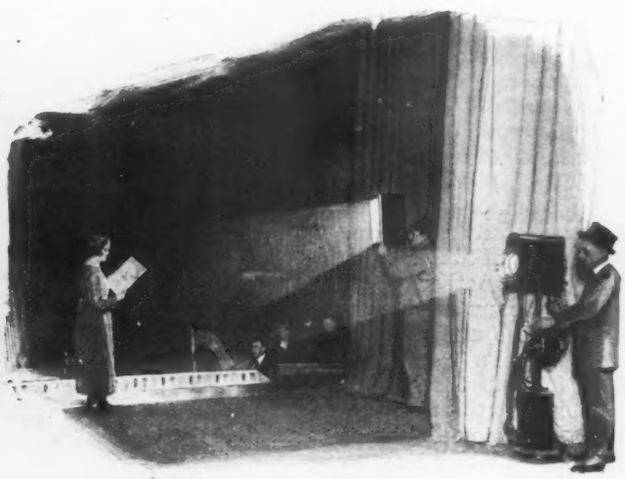
The switchboard operator merely turns the handle of a wheel gradually to reduce or increase the current, causing the lights to grow dim or bright

Fireproof metal cases are used to keep the film in the projection-room. Other precautions are taken to prevent a fire. The metal doors and shutters are arranged to close the instant a fire starts





This is the projection-room of New York's largest theater, the Capitol. There are four large two-thousand-feet projection machines having an indicator like a speedometer that shows the number of feet being run off



For the theatrical part of the performance various spotlights are used. These are composed of one-thousand-watt incandescent lamps and powerful arcs. Colored gelatin filters are placed in front of the light for variety

The *Leviathan*, flying in the swift winds of lofty altitudes. The engines as well as the passengers are enclosed in a sealed room, where atmospheric pressure at sea-level is automatically provided

High Flying in a Sealed Airplane

HIGH altitudes are uncomfortable for passengers and engines alike. The dearth of oxygen makes breathing uncomfortable, while the thin air and lack of oxygen spoil the proper functions of a gas-engine. To navigate the region of high winds, where astonishing speeds could be attained by taking advantage of the favorable currents, requires a special type of airplane.

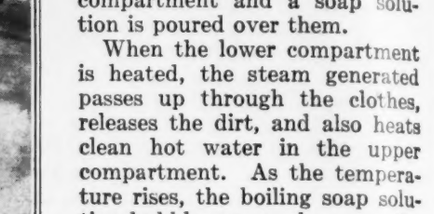
A diver can descend several hundred feet under water only when he is enclosed within a suitable diving-jacket. Now comes the amazing suggestion that airplanes intended for lofty altitudes, from twenty thousand to thirty-six thousand feet, should have hermetically sealed compartments for passengers and engines. The idea is a development of the "enclosed car" invented for balloons by Louis Tridon in 1871. This comprised two platforms hung from the balloon, the upper platform being used as a maneuvering car. When the craft reached the high region of the air, the pilot descended through a manhole into the closed compartment below. Here oxygen flasks were placed, and there were clothes saturated with lime water to absorb the carbon-dioxide exhaled from the lungs.

Louis Breguet has devised the modern aerobus for altitude flying. The *Leviathan* is built entirely of metal, and its motor power consists of four eight-cylinder engines having a total of nine hundred and fifty horsepower.

Let Steam Do the Family Washing

A GERMAN has invented a boiler in which the whole process of clothes-washing is carried out. It consists of an upper and a lower compartment. The lower compartment contains a receptacle with a central spray pipe and a clothes cover. The clothes are placed in the lower compartment and a soap solution is poured over them.

When the lower compartment is heated, the steam generated passes up through the clothes, releases the dirt, and also heats clean hot water in the upper compartment. As the temperature rises, the boiling soap solution bubbles up, gushes over the clothes cover, and back into the clothes. After half an hour the dirty soap solution is drained off. Hot water from the upper compartment takes the place of the discharged soap solution.



The dirty clothes are placed in hot, soapy water, which bubbles over the clothes for half an hour; then the dirty water is drained off

Handling Lumber with an Electric Monorail

WITH a new electric monorail system designed specially for lumber-yard work, loads of fifteen hundred feet of lumber may be picked up and moved from one point to another as easily as you can lift a glass of water from one table to another.

Upon the monorail system is run an electric hoist and operator's car. The hoist picks up the lumber and moves it to any point along the monorail system, the tracks of which may be swung between buildings, freight-car loading stations, or on wharves for lighter loading. Current is carried in cables supported on insulators attached to the monorail track.

A special type of cradle is used in carrying the lumber on the monorail; the system is very useful in the loading and unloading of ships

One of the details that has made this handling both quick and economical is a special type of cradle for picking up the lumber and holding it while it is being moved from one point to another. This cradle is made in two parts, separated by a ball-bearing race, so that the lower part, which carries the lumber, may be swung around and the lumber picked up or deposited in any position.

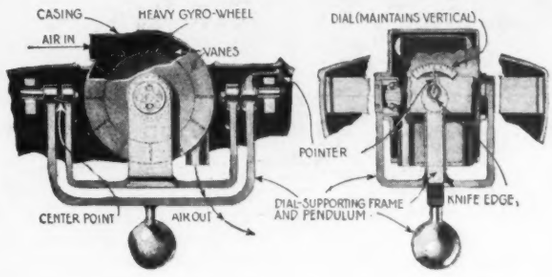
Another quick-action feature is the four grapple-hooks, which fit around the two cross-timbers upon which the lumber is piled.

Steering with the Gyroscope

ONE application of the gyro-toy is a device to enable an airplane or motor-boat to steer an absolutely straight course in dense fog. This is not the now famous gyro-compass, but a new and exceedingly sensitive mechanism.

The device that pilots the aviator straight as an arrow on his course consists of a heavy-rimmed gyro-wheel having on its circumference blades similar to those of a water-wheel, and mounted inside a cylindrical casing. This casing is pivoted so that the mechanism is a gyroscope with two degrees of freedom. The wheel turns about an axis, and the wheel and casing together are free to turn. There are two openings in the casing, one to admit air and the other to release it.

The airman can keep his course, even through fog, if his plane is equipped with the application of the gyroscope shown below. The device can also be used on a motor-boat



As the airplane is driven rapidly forward, the admitted air will drive the gyro-wheel at a tremendous speed. Its inventor states that this speed may be as high as twenty thousand revolutions a minute. Therefore the very great inertia developed tends to keep the wheel rotating with the axis constantly pointing in the same direction, that is, crosswise of the car, and with the pointer in a vertical position. But, let the airplane turn ever so slightly to the right or left, and the gyro-wheel, being subjected to another curvilinear motion, immediately begins to precess. Like any other gyroscope under similar circumstances, the gyro-wheel instantly responds to the new motion and places its axis along a line between the horizontal and the vertical. Consequently the pointer is deflected from its zero position and warns the aviator of his deviation from a perfectly straight course.

This precessional movement is literally quicker than human thought, and, however slight the turning of the airplane may be, its effect is immediately registered. A movement upward or downward, either in a straight line or a curve, has no effect upon the gyroscope, for it does not change the direction of its axis of rotation.

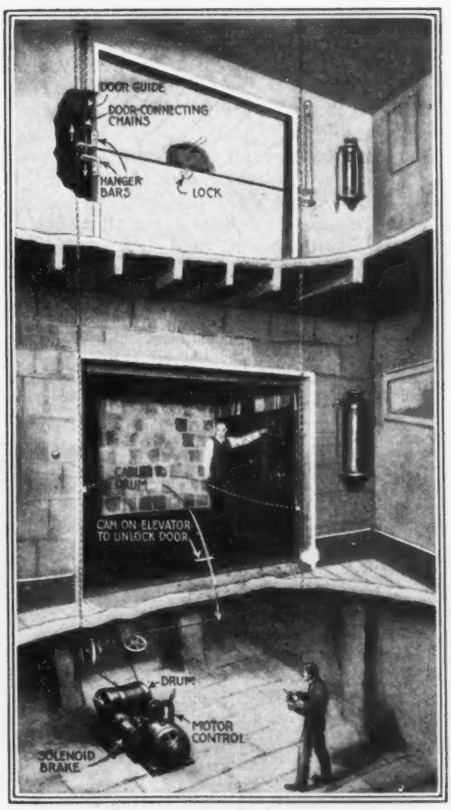
The device may also be used on motor-boats, but at low speeds the gyro-wheel would not rotate very rapidly.

Elevator Doors Operated by Push-Buttons

THE job of an elevator operator looks easy. But when the elevator is of the freight type, with the floor openings protected by heavy doors that must be opened and closed each time goods are put on or taken off the elevator, the operator is fagged out at the end of the day.

To save the man-power of the elevator operator and thereby speed up his work, electrically opened and closed doors have been devised. These new doors are so evenly balanced that they may be instantly opened or closed by simply pushing a button.

The doors are made in two sections, one above the other, and are hung, as shown, by chains, rods, and pulleys. All the doors are electrically interlocked so that the elevator car is inoperative until the doors are closed and locked. The operating machine is located in the basement of the building, and consists of a motor mounted on a machine base, with a solenoid brake for driving a cable drum with worm-and-gear reduction. Two steel cables fastened to the drum lead up through the shaft, one on each side of the line of doors, and pass through the hanger bars at the upper part of the lower section of each door. To open the door, the drum unwinds the cable, allowing the door to part, the lower section being overweighted, thereby causing the two sections to part simultaneously. The remaining doors are held in place by a lock, a cam on the elevator car releasing this lock as the car approaches each landing.



These doors are made in two sections, and are electrically interlocked so that the elevator car can not move until the doors are closed and locked

These doors are also very safe and there is practically no danger of a person getting caught when they come together. If a man did get caught in the door, the operator of the elevator could open them instantly to release him, by merely pressing the button.

Sugar to Detect Typhoid

TYPHOID germs thrive on sweets. Thus physicians often use rare fine sugars for detecting them. The germs will rapidly multiply when in contact with the sugar and will soon make their presence known.

Heretofore Germany has monopolized the rare-sugar market, but now many manufacturers are able to produce these sweets. Some of them cost several hundred dollars a pound, for the process of manufacture is very slow.

Due, undoubtedly, to the use of these sweets, a comparatively small number of our men died of typhoid in the recent war.

Grinding Wheat for the Neighborhood

WHEAT unground can be purchased at a comparatively low cost. When white flour is made, the outer portion of the wheat grain is removed, and with it the more nutritive element of the wheat.

During the war, the suggestion was made that people grind their own flour in a coffee-mill. Some people, who did not have the time or the facilities for grinding, combined their interests and bought one of the old-time mills with stone burrs that produced wholesome whole-wheat flour. Thus arrived the "community mill," grinding flour for the neighborhood. Men and women took turns at grinding wheat and baking the bread. It was fine, palatable bread, and much cheaper than that bought at the grocery.

Six Hundred and Fifty Cigarettes a Minute

DO you "roll your own"? If so, you know that, working at top speed, you can roll only two cigarettes a minute. And they will very likely be too thin or too fat, too tight or too loose. Machine-made cigarettes are practically perfect, and they are turned out by the hundred.

One of the latest cigarette-making machines is shown above. It was invented by an Englishman named Baron, and it is quite the fastest worker of them all. It will make six hundred and fifty cigarettes a minute.

M. Baron, the inventor, is the man with the derby hat in the picture above. He is watching his assistant operate the machine.

Grass that Sells by the Yard

"SEND me ten yards of thirty-six-inch grass."

Grass is sold by the yard as if it were cloth, now that Mr. MacDonald, of Harpenden, England, has discovered that grass will grow on a bolt of goods as well as in soil.

He lays out yards of cloth on the floor of his greenhouse and sows grass seed thereon. When the grass has grown sufficiently, the cloth is rolled up and shipped to the buyer. Then the cloth is stretched out on the level ground of the lawn-to-be and in a few days the roots of the grass will have got a good foothold in the ground.

Lawns made in this manner can be used shortly after they are laid.

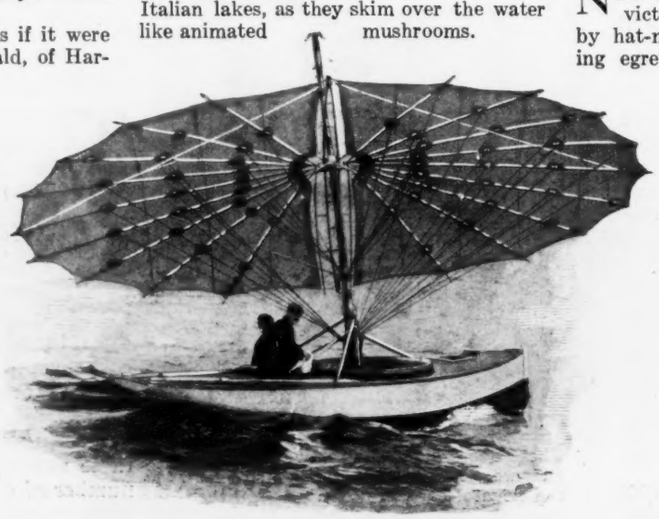
The Sails Form an Umbrella Over This Boat

TWO Italian airmen have devised a novel craft, known as the "umbrella-boat." It is shown in the illustration below, with the inventors in one end of the craft enjoying the sun and breeze.

The sail is made oval in form. Two sections make up the sail. These open and close like a fan, and the pair can be furled in about a minute.

Fore and aft the sail is a fixture. It is tilted sideways to take the wind from either quarter, and by actual trial, so the inventors claim, it has been found that the wind in the sail has no tendency to heel the boat over if the sail is properly designed and adjusted.

Should these boats become popular, they would add a picturesque touch to the blue Italian lakes, as they skim over the water like animated mushrooms.



Elephants' Whiskers on Hats

NOW it's the elephant's turn to be the victim of fashion; it has been elected by hat-makers to relieve the long-suffering egrets and birds of paradise. Its whiskers will henceforth adorn women's hats.

Just why an elephant has whiskers, when the rest of its body is practically hairless, is puzzling. But, since it has them, they must be of some use, and surely ought not to be removed. Who knows what terrible change this may work in its disposition?

Above you see an elephant that opened its mouth expectantly when its keeper approached. It undoubtedly expects that a dainty morsel of food will be dropped on its tongue. What it will do when the keeper starts clipping is left to the reader's imagination.

A Gorilla at the Crank

CRANKING a car is not so simple as it seems. If you don't handle the crank with care, it may jump back at you and break your wrist.

There are many people who will not attempt to crank a car. Yet John, the huge black gorilla below, does it with the utmost indifference. Does he realize the risk he takes? Or is he very wise and does he understand the secret workings of cranks and crankshafts?

John is a vaudeville actor, and he makes his headquarters in London. When this picture was taken, he was exhibiting his skill before a crowd at the Olympia in London.

© Keystone View Company

This Back Yard Is Built on a Foundation

IF your land is thirty feet below front street level and the rear is ninety feet lower than the front, how can you build on it? This problem was solved by a New York architect.

The steep bank of the Hudson has been turned into a building-lot by constructing a foundation higher than the house erected on top of it. The foundation is hollow; but its strength is more than sufficient to carry the six-story house.

The space for a yard back of the building, on the street level, has been gained by the addition of a platform supported by an upright frame, the weight of which is carried on concrete bases.

Germs, Beware!

"KERCHEW!" Some one sneezes in the crowded subway train. All the people near are much alarmed; but, since they can't move, they must accept the deadly germs showered around.

Now, however, there is a small pocket inhaler that will kill these germs before they do any damage. When some one sneezes, get out your inhaler, put one end in your mouth, and breathe. The fumes you inhale will kill every germ that happens to be in your lungs at the time.

This handy little inhaler opens and closes like a folding metal cup.

Turning a Log into a Bridge

A GREAT elm fell to earth with a crash. It landed firmly across a bank, the center part remaining in the air. In a short time the boys near by were climbing on it and running across it.

It was far enough off the ground to act as a bridge, and the residents decided to make a real one of it, and thus satisfy a craving in the hearts of most of us, to climb obstacles.

The twigs, small branches, and bark were removed, and the upper side was shaved off until it became flat. A railing was built at one side of this upper surface, and the log became a full-fledged bridge.

Digging the Cellar Last

ONCE a contractor was called upon to erect a large concrete building during very cold weather. The ground was frozen so hard that he was unable to make an excavation for the cellar. This fact did not deter him in the least. He went ahead with the building and dug the cellar later, when the weather was warmer.

This Is a Hotel!

GAZE upon the Hotel Lutz, Oil Town, Oklahoma. The rates? About five dollars a day. Pay this or sleep in the open.

Note the absence of bell-hops, coachmen, and taxicabs. This is the kind of a hotel that springs up overnight after oil has been discovered. When this happens, communities develop rapidly and there is not time to construct a more elaborate place to sleep. People rush to the spot and they simply must have a place to lay their weary heads. The way of the pioneer is hard indeed. These mushroom oil-towns usually fade out of existence as quickly as they appeared.

Curing the Sick in the Zoo

THE animals residing in the New York Zoological Park receive instant attention if they show the slightest signs of illness. The physician in charge of them has the walls of his office lined with shelves, on which medicines of all kinds are kept.

If a keeper reports that one of his dumb charges seems to be poorly, and is losing weight, the cod-liver-oil bottle is brought forth. In many cases the animals are given the same sort of medicine as that which humans get when they are sick.

Sulphur is used for curing blood diseases. Phosphate of lime is administered to strengthen the bones. Sugar of lead is sometimes given in cases of a very severe illness.

She Holds the Largest and the Smallest Boots

A BOOT manufacturer well known in the United States made these boots, just to see how large and how small boots could be made. After he produced them he took them to a convention of boot manufacturers to show his brother manufacturers the two extremes of boot-making. The small boots are so tiny that they just fit the fingers of the girl. Then this pretty young lady was asked to take the big boot and all the little boots and pose for a photograph for use in the Popular Science Monthly.

The big boot has in it the same quality of material as the smaller boots. It is also surprising to know that the same process was used for the manufacture of both these boots.

It would take a big man with big feet to fill this boot. Mr. Johann Van Albert, a giant Hollander, who recently came to this country, is eight feet, five inches high. Would this boot fit him? He takes a number thirteen shoe, but this one must be at least forty in size. It would be much too large even for this giant.

Guarding the Punch-Press Girl

FOR guarding the hands of punch-press operators a safety device has been developed by an Ohio manufacturer.

If the operator's hand is not withdrawn from the die when the punch starts to come down, a wire arm sweeping across the front of the press pushes it gently away from danger, a necessary precaution for girls, who frequently forget work in daydreaming. A pin attached to the crankshaft bearing-cap gives this arm its reciprocating motion.

The device can be mounted on any press, and the swinging-arm part of it may be removed and replaced whenever desired.

Many Foods in One Dish

WHY does the sailor call his food "chow"? Because chow is an abbreviation of chowchow; and chowchow, according to the dictionary, is "a mixture of all sorts of things."

The sailor's meal is served on one large plate, and it soon becomes a mixture of all sorts of things.

Now, however, there is an aluminum plate that contains six separate compartments—a large one for meat and five smaller ones for vegetables and dessert, giving a bird's-eye view of what the navy offers its sons for nutriment.

The plate is just as easy to clean and store as the usual flat plate.

It is now being tried out in the navy, and perhaps before long the word "chow" will become obsolete.

A Hat-Bag for the Theater

HOW do you dispose of your hat when you go to the movies? If you hold it in your lap, you will probably drop it when the picture becomes exciting. If you slip it in the wire holder under the seat, it can easily slip out and get walked on.

There is now a bag that will fit under the seat and will hold all your belongings safely. It was invented by John Pidgeon, of New York.

The new bag is made of strong cloth—usually cretonne—and is attached to a wire frame. You put your hat in it when the seat is up. Then you close the bag by means of a wire arm.

Beautifying the Old R. F. D. Mailbox

THE usual R. F. D. mailbox is a simple affair of tin and wood—efficient but ugly. It stands out in front of the house and spoils the looks of the place.

What's the remedy for this? Build more stately boxes.

Below you see a mailbox that is made like a birdhouse. It is divided into two floors—the lower one for papers, magazines, and packages, the upper one for letters. Each floor has its own separate door, which the mailman opens when he arrives. The upper floor is lined with tin to protect the letters from a possibly leaky roof. If you decide to try out this birdhouse-mailbox, don't be surprised if you find the makings of a bird's nest in the midst of your mail some fine spring morning.

Hot Springs in Iceland

STRANGE as it may seem, there are several hot springs in Iceland. Thus the inhabitants are supplied with a constant flow of boiling water. On wash-day the women carry their soiled clothes to the nearest spring and let nature do the rest.

In the picture below you see three women at work in Reykjavik, the capital of Iceland. A metal railing has been placed over the spring to prevent the women from accidentally falling in.

Incidentally, the railing supplies the women with a place to hang clothes while others are washed.

Make Your Own Records

IF you believe that your singing voice is as good as any you've heard on the phonograph, then you need one of the new home recorders.

The recorder consists of an adjustable bracket and arm, a horn, a metal guiding-plate and finger, and a recording needle. Attach the bracket to the front edge of your talking-machine, and adjust the arm to suit your particular machine. Fit the metal guiding-plate, which is spirally grooved, over the spindle of the turntable, and place the metal finger in the outside groove.

Place a blank wax record on the machine and set the recording needle, take a deep breath and pull the release lever. The finger on the grooved plate guides the needle as you sing.

United States Wealth per Capita

ADD up all the money in the country, then count the number of people, and you will be able to tell the average wealth a person by dividing one number into the other. The Federal Reserve Board announced recently in its monthly bulletin that the per capita wealth in the United States is $51.06. This may not seem very large, yet it is $13.18 higher than the per capita wealth as estimated in the year 1917.

The Boot that Prevents a Prisoner's Escape

HERE are three men. One is the brother of the victim of a murder, another is the prisoner condemned for the crime, and the third is the officer of the law.

It is easy to distinguish the prisoner by the curious weight that is attached to his right ankle. This is an invention of a former inmate of a prison.

A metal frame fastened to the bottom of the heel supports the cast steel weight, and the prisoner feels the brunt of the burden he must lift only when he attempts to walk.

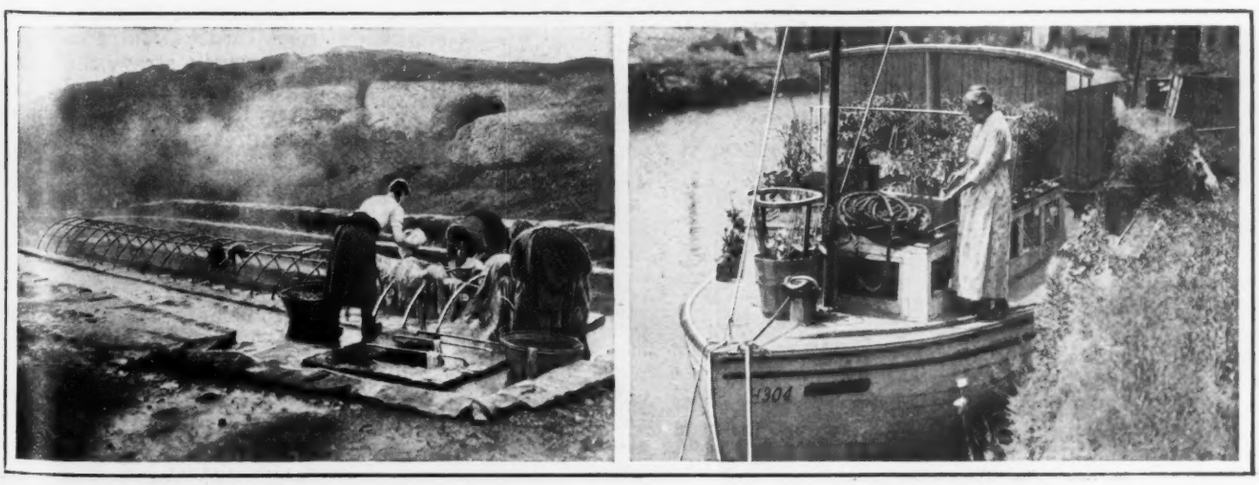
It is necessary for him to walk very slowly when he is encumbered with this non-escaping device and a quick getaway is an entirely unknown quantity to him.

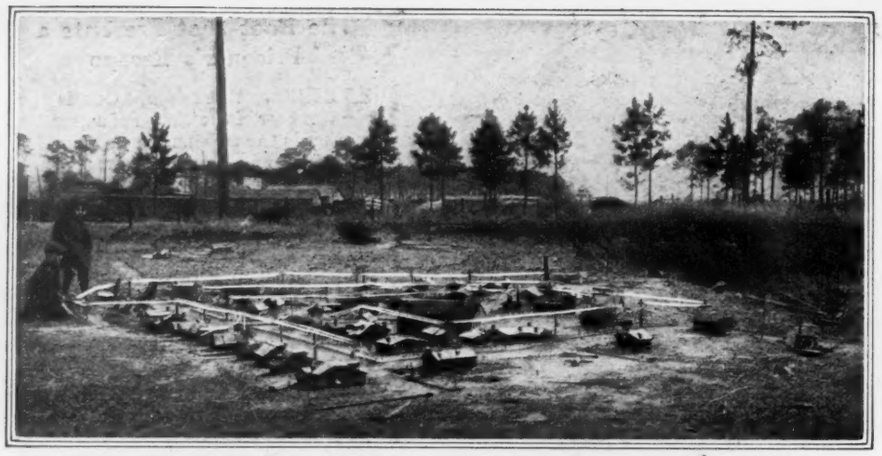
© Kadel & Herbert

A Floating Vegetable-Garden

LIVING in a boat on the river and growing one's own fresh vegetables is an experience not enjoyed by many people. Here is a resourceful woman who not only grows everything from lettuce to tomatoes in sufficient quantities for her own use, but has some to sell each season.

If the houseboat dweller obtained the privilege of cultivating a small garden in an unused plot near the river-bank, the small investment would be a paying one. The products of the soil could be harvested and conveyed to ready markets, the boat itself becoming a floating "market-wagon."





This miniature village was built by the small boy who is kneeling. The streets are paved and strung with electric wires, connected with a power plant

His Play Is Building Villages

YOUNG Paul Schmoll, Jr., still wears short trousers and has a high soprano voice, yet he has already built an entire village—in his back yard. It is so marvelously constructed that people are always visiting it. Both the youthful builder and the village are located at Mobile, Alabama.

The village covers an area of about four hundred square feet. In it there are fifty cottages made of wood, with asphalt shingles. The streets are all paved, curbed, and strung with electric wires connected with a small power plant. There is a sawmill, a post-office, a school, a hotel, a museum, a park, a playground, and a complete fire department, all built to scale, in this tiny village. There are also stores and churches.

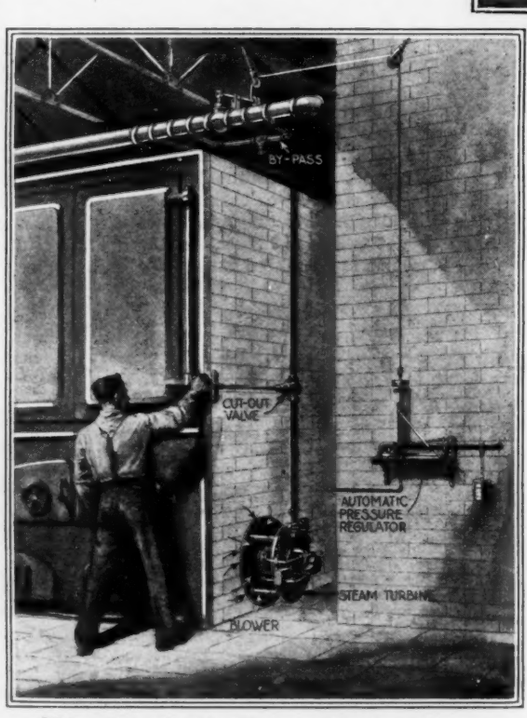
The architect and builder may be seen in the picture above, kneeling, and explaining to a younger boy just how it works.

The Draft that Never Fails

IF a steam plant is not watched carefully, many thousand dollars can roll out of the chimney in the course of a year. The greatest loss is caused by running the boiler at maximum capacity while the actual need of the steam-engine or -turbine may vary through a fluctuating load. A large part of the surplus energy is wasted.

Natural draft in a chimney also fails at times, and on a still day the fireman may have a difficult time keeping the fire at a point where it will meet the needs of the plant. These problems are overcome by the installation of a mechanical blower that will cause just the right amount of air to circulate through the firebox. Such an installation saves the cost of building a high chimney and insures uniform operation.

This blower is driven by a small steam-turbine that is fed by the boiler in connection with which it is used. The fan of the blower is mounted upon the same shaft with the rotor of the turbine. The speed of the blower determines the amount of air entering the firebox. Automatic regulation is obtained by attaching a device to the steam feed-pipe. If the steam-engine or -turbine is called upon for extra duty, the increased movement of the steam in the main feed-pipe actuates a valve, permitting more steam to flow into the turbine of the blower.



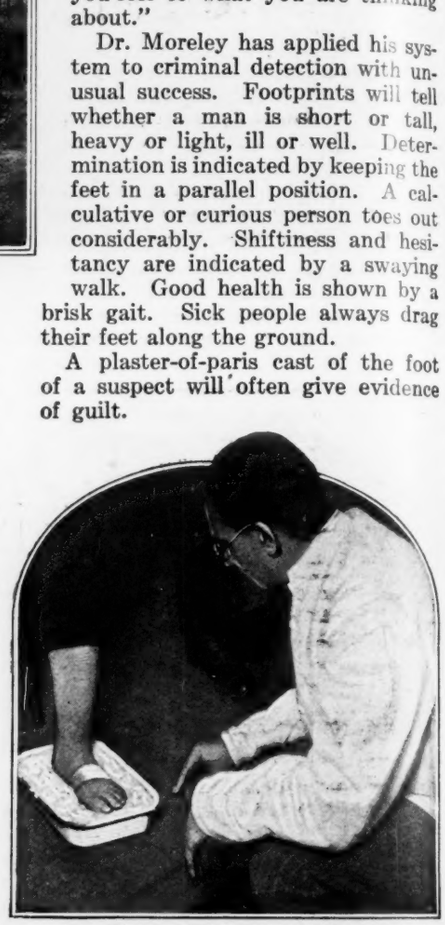
This automatic blower keeps the fire able to meet the needs of the engine-room

By Their Footprints Ye Shall Know Them

SAYS Dr. Charles W. Moreley, a chiropodist: "Let me see your footprints and I will tell you how you feel or what you are thinking about."

Dr. Moreley has applied his system to criminal detection with unusual success. Footprints will tell whether a man is short or tall, heavy or light, ill or well. Determination is indicated by keeping the feet in a parallel position. A calculative or curious person toes out considerably. Shiftiness and hesitancy are indicated by a swaying walk. Good health is shown by a brisk gait. Sick people always drag their feet along the ground.

A plaster-of-paris cast of the foot of a suspect will often give evidence of guilt.



Fingerprints are used in criminal detection—why not footprints? So reasons Dr. Charles W. Moreley, who has developed a system of detecting criminals by footprint

Putting Flax Straw to Use

FLAX straw was thrown away as waste in former days, but now it is used in the manufacture of rugs, carpets, and upholstery. The longer the straw, the better the price paid for it. In this country, the flax from Wisconsin is of the greatest length, says Mr. A. H. Wright, of the College of Agriculture at Madison.

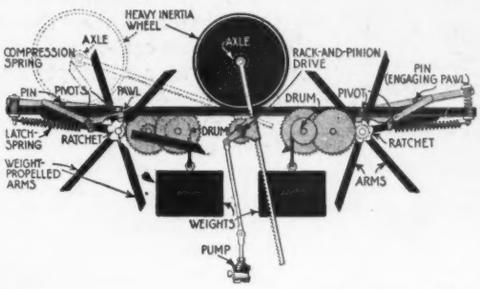
In Germany flax straw has been mixed with coal and used as fuel. But this mixture has not been successful, according to reports from the research station at Sorau. Too much labor and expense are necessary for the amount of heat gained. The ashes must be removed frequently. There is also incomplete combustion.

Wind It Up and Let It Work

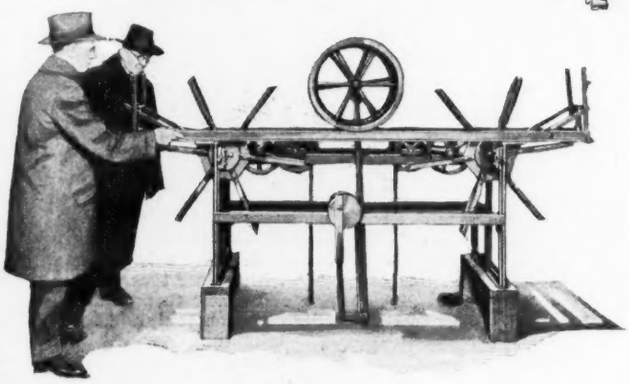
THIS weight motor is made to help do the chores on the farm. It will pump water, turn the churn, and drive the grinding-wheel—if it is first wound up. It is really a machine for storing up muscular energy and using it at will.

A weight attached to the end of a long rope is wound on a drum and allowed to drop again, thereby imparting motion to the drum. The power of the moving drum is transmitted through a train of gears to the machine that is to be driven. The weight is heavy and falls slowly. The ratio of the gearing is such that the driving wheel of the machine revolves at a fair speed, while the drum turns very slowly. The same principle is used to drive clocks. The farmer will have two things to wind up now before he retires—the clock and the weight motor.

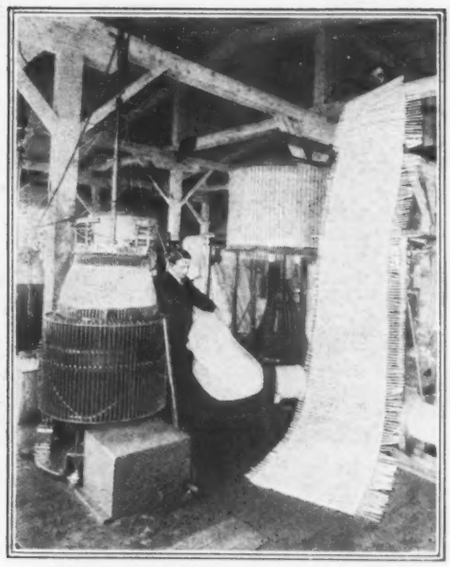
When he gets up in the morning the weight motor will be ready to help with the farm chores. It will be necessary only to release the energy that was stored up the night before.



How it works. The raised weights cause the heavy inertia wheel to oscillate and thus to operate the pump



A "two-cylinder" weight motor. Weights attached to long ropes are wound up on drums and allowed to drop



This is the first successful wicker-weaving machine. The shuttle and weft are stationary, whereas the warp is woven

Speeding Up an Ancient Industry

"ANY fish to-day, lady?" Not so long ago Marshall Lloyd, of Menominee, Michigan, was going from back door to back door asking this question. He was a fishmonger. And now he is a millionaire!

His wicker-weaving invention did the trick.

Since Biblical days wicker-weaving has been done by hand. The mother of Moses, so the Bible tells us, wove the basket in which she sent her son down the River Nile. And her method of weaving was just the same as the method used to-day. Mr. Lloyd's machine is the first successful one of its kind.

Mr. Lloyd's first step was to find a way of holding the upright stakes or weft without attaching them to a frame. Then he built patterns for various articles, and built the drums of his looms after these patterns. Contrary to all other weaving methods, he uses a stationary shuttle and weft, and weaves the warp. Mr. Lloyd is using nineteen looms in his factory, and they are doing the work of five hundred and seventy high-class workmen.

Loading an Airplane through Its Nose

IN all forms of transportation, the cost of operation, including capital, establishment charges, running cost, maintenance, etc., increases roughly as the cube of the speed of the carrier. Without considering the fuel for power, the cost mounts as the square instead of the cube.

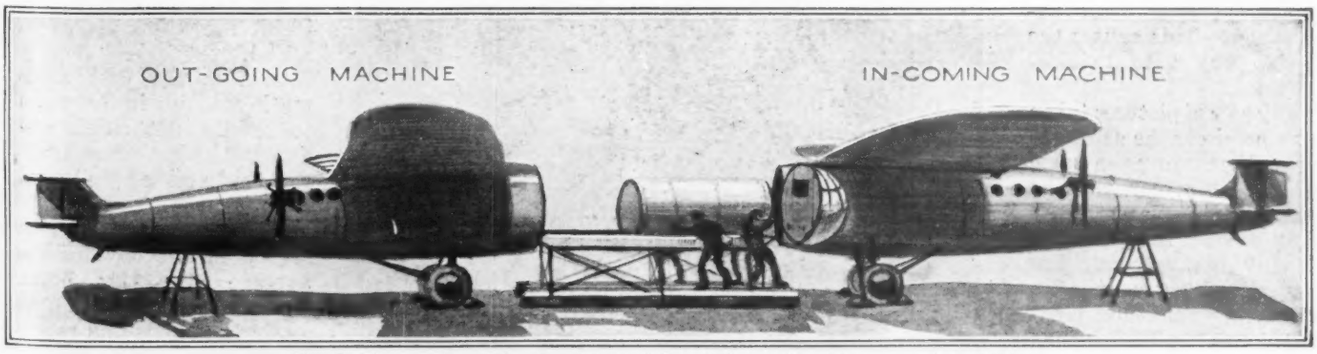
Cargo-ships and freight-trains operate at the lowest practicable speeds. Air traffic will follow this same law, and its most practicable paying speed will be found.

The flying "tramp" shown in the illustration below carries four tons of freight at a speed of seventy-two miles an hour. This is a low practicable speed for air travel, but it is much faster than any other mode of transportation.

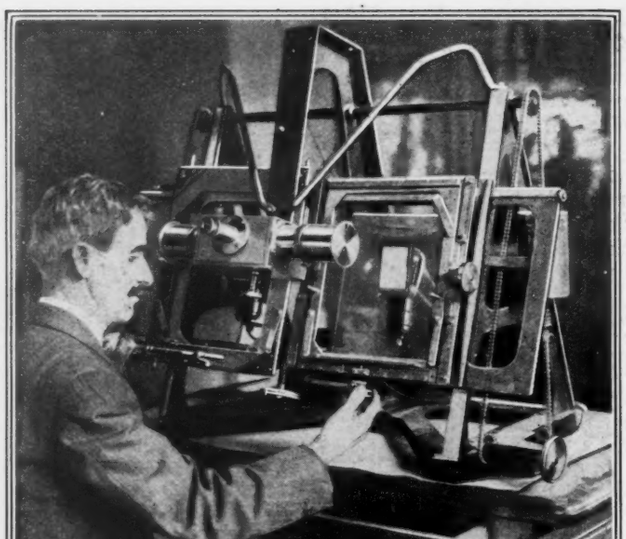
The air route also takes advantage of the shortest distance between two places.

With rapid modes of freight handling, and by changing cargoes from "ship" to "ship" as shown here, time also is saved.

The pilot-house in the nose of the machine is swung back on special hinges, the cylinder containing the cargo is run in on guide rails, and the craft is instantly ready to be off.



The freight-carrier of the air. The freight will be enclosed in a container that can be transferred from one airplane to another in the manner shown here



Using a "blink" microscope. The plates to be examined are in frames. The observer looks through the eyepiece and sees both plates as one

Discovering New Stars

HOW do astronomers quickly discover new stars, or variable stars, comets, or wandering planetoids, many of which are too faint to be seen except by the method of photography? How can one compare two negatives of the Milky Way region in which literally thousands of stars appear, and instantly pick out a tiny star-dot on one negative that does not appear on the other? The "blink microscope" saves hundreds of hours' work for the astronomer in the laboratory.

This instrument is so arranged that separate images obtained with separate lenses are made to coincide as viewed at the eyepiece between the lenses. The arrangement is that of a range-finder in which reflecting prisms are used. Each negative is illuminated by an electric bulb connected with a device that alternately cuts off the light from each.

The alternations are so perfectly timed that when both plates are identical, the image, as viewed at the eyepiece, remains steadily illuminated. But if an object is present on one negative that is absent on the other, there will be a gap in the interval of illumination. This causes the foreign object to twinkle, or "blink."

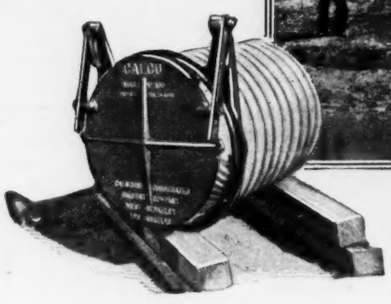
Any pair of pictures taken from precisely the same angle and including the same field of view, can thus be compared. A new star will blink among thousands of steadily shining stars, a new battery emplacement in an otherwise unchanged landscape, as photographed from the air, will "blink," thus disclosing its location.

An Aid to Irrigation

THE farmers in the great West, where during certain seasons it is more arid than the East, must pay more attention to their irrigation problem. They must handle with care the water Nature bestows upon their fields during the rainy part of the season.

The culvert shown in the illustration has been designed to aid the Western farmer in keeping his fields in good condition. With it, he may allow water to pass from one field to another with no danger of its passing back. The return of the water is prevented by a sensitively balanced door that allows it to pass in one direction only. The cast-iron door of the culvert closes with a bang if the water attempts to return to the field whence it came.

With these culverts connecting his various fields, the farmer may flood one field after another, thereby making good use of the little water he has at his disposal.

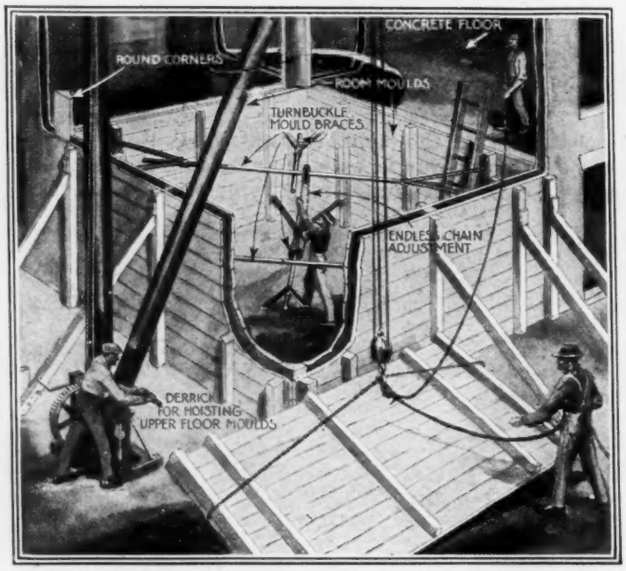


This culvert is provided with a door that will permit water to pass in one direction only. At the left, the door is shown closed

Mold the Rooms as You Go

STANDARDIZED building can be assisted by the use of a simple device by which the rooms of a house can be molded complete as the structure rises.

Here is an invention that enables the molding forms to be raised intact from the inside. The four walls of the room-forms are held in the grip of adjustable mold braces on the inside of the room, while the outside sections are elevated by derricks. The invention is that patented by C. N. Wisner, of New Orleans.



Concrete molds held by an automatic bracing which needs only to be loosened to be elevated into position on the next floor

Reenforced-concrete supports at the corners of the room are curved so as to provide round corners for each room. When the concrete has been poured and has set, the interior braces are loosened and the whole form is elevated to the floor-level of the second story. When this is finished, the forms are again raised.

This is the first automatic machine in the world to handle unit molds and automatically to regulate the thickness of walls and columns as desired. The molds on one floor can be set up in one day for the average size city hotel. Doors and windows can be set in the molds and rooms of different sizes can be built.

He Altered the Shape of His Violin

WHY are all violins shaped alike? Because of the superior resonant qualities of that particular shape.

One violinist, Everett E. Dunham, of Seattle, Washington, liked to hit the high notes, and he found that the generous curve of the violin interfered with his forearm. So he chopped a large slice off the side of his violin, healed up the wound with a thin strip of wood, and proclaimed that his violin was as well as ever. In fact, he decided to patent his idea.

The cut extends diagonally from the top of the curved part of the violin to the bottom of the upper half, and runs parallel to the forearm when the violin is held in position for playing.

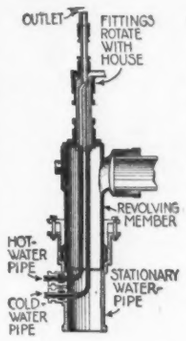
The upper curve of his violin interfered with his forearm when playing the high notes, so he chopped it off, mending it with a thin strip of wood

A revolving house in use in a hospital. A square opening is cut in one side to admit more sunshine. The patient within swings his house around to follow the sun

Press the Button and This House Revolves

FOR the benefit of people who need lots of sun, Samuel Stevens, of Asheville, North Carolina, has invented a revolving house that enables the inhabitants to be in the sunshine as long as the sun is visible. All a sick person need do is to press an electric button and his house will revolve.

This simple operation is made possible by machinery that is completely hidden in the foundation of the house.



The floor of the house is supported near the edge by joists that rest on a metal ring. The ring rests on ball bearings that fit in another ring mounted on a concrete foundation. A rack is attached to the joints near the place where they rest on the ring. A pinion connected with an electric motor meshes with the rack.

When the power is turned on, the motor revolves and so does the pinion. As it meshes with the rack, the house mounted on the rack revolves too. When the desired position is reached, the power is turned off and the house becomes stationary.

The plumbing and wiring are not affected at all by the revolving. A large central pipe that revolves with the floor contains all the wires and pipes. This central pipe is attached to a stationary one at right angles to it.

How a Canyon Was Changed into a Theater

THAT a rugged canyon can be converted into an open-air theater has been demonstrated in southern California, where an organization of artists and players recently established the "Pilgrim Play" as a permanent institution that will run ten weeks a year.

The "Pilgrimage Play" is a dramatized version of the life of Christ, patterned after the "Passion Play" given at Oberammergau.

It was decided that El Camino Real canyon, a ravine in the hills back of Hollywood, California, offered the best possibilities. So fifty thousand dollars was raised in a national campaign, and an auditorium built that is now the marvel of many architects.

A natural amphitheater where the "Pilgrimage Play" is given in California. A hillside furnishes the scenes in the life of Christ, several platforms providing the different stages for the performance

The auditorium was built at the apex of the ravine, allowing the front of the theater to run down toward a point, while the seating space widened at the rear.

The approach to the auditorium is marked by winding paths fringed with rock from the ravine. In the foreground is a ticket-office, and a little farther along is the front of the theater, a wall built to imitate the architecture of Bethlehem, Jerusalem, and other cities of Palestine. You pass through the entrances of this wall, turn either to the right or left, walk up a flight of stairs, and reach the floor at the rear of the stadium. There an usher shows you to your seat.

A Trapper's Life Is Not an Easy One

Long months of lonely discomfort

© Hudson's Bay Company

In the spring, when women are casting aside their heavy fur coats, the hunters in the north are returning to the fur post with skins for next year's coats. They hunt all winter and often suffer severe hardships

© Hudson's Bay Company

Here are eight thousand dollars' worth of fox-skins being baled for shipment. When a hunter sets a trap for fox, he may catch a red one, worth thirty dollars, or he may catch a thousand-dollar silver fox

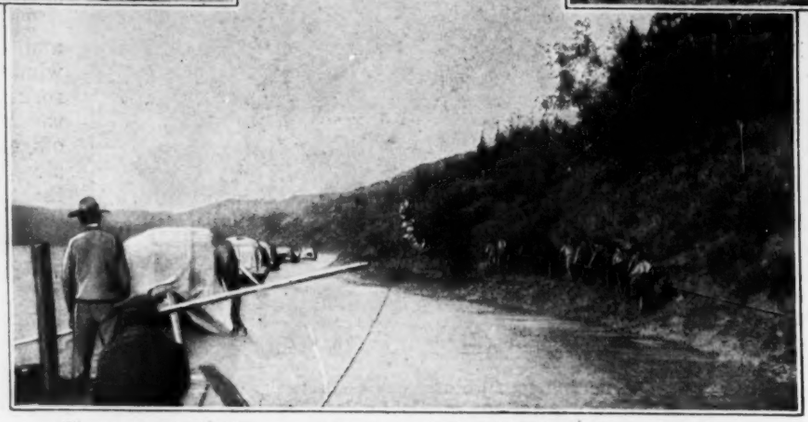
And this is why men endure the Arctic cold and suffer hardship

© Hudson's Bay Company

Fur presses are primitive devices of wood and iron. Four of them in use in Hudson's Bay Company posts are more than a century old. Formerly the company owned great tracts of land, but these were surrendered to Canada in 1870

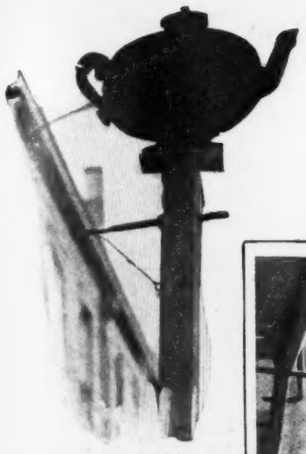
© Hudson's Bay Company

The hunter lays out his trap line—sometimes 200 miles long—and builds cabins, in which to sleep and eat as he goes the rounds. He sees no human being for months, but when he returns he brings thousands of dollars' worth of beautiful pelts



There are practically no power boats in the Far Northern rivers. Trackers, usually Indians, toil along the shore, pulling the boats laden with furs

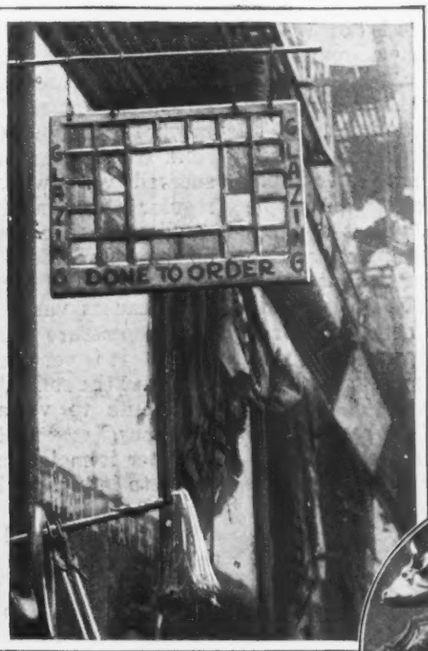
The Old Sign Still Sways in the Wind



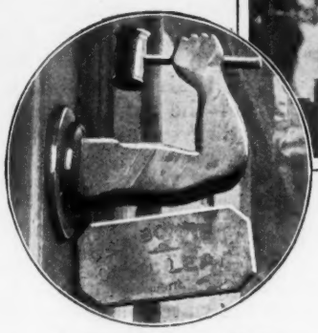
For years a wooden teapot has guided thirsty throngs to a New York tearoom. Should you stand directly in front of the teapot sign, you would see that it is carved from a narrow board

Above, you see an old-fashioned coffee-pot that hangs outside of an old-fashioned coffee-house. Now that saloons are ostracized, it is possible that coffee-houses will come to the fore again

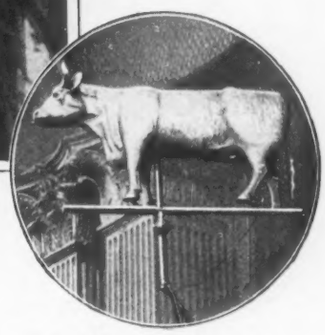
A red-and-white umbrella flapping in the breeze would seem to indicate either umbrellas to mend or umbrellas for sale. The one above, on the contrary, hangs outside a haberdashery



A glazier, to show the kind of work he did, made a sign of small glass panes and fitted them into a frame. He printed the words, "Glazing Done to Order," around the edge of the frame

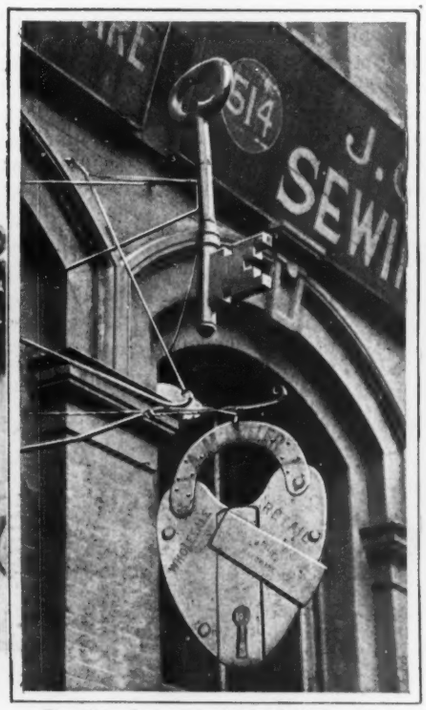


A muscular arm brandishing a hammer indicates that something is going to get a beating. In this case it is gold. The arm is fastened outside the door of a gold-beater's shop



An iron cow might signify that the owner of the shop sold cows; but on investigation we learn that the owner of the iron cow is an iron-worker. The cow is a specimen of his work

This artificial horse stands between a harness-maker's shop and an undertaker's establishment. It belongs to the harness-maker of course



People who never locked their cellar-doors before this year are doing it now. Thus there is plenty of business for the locksmith, who makes his presence known by the sign above

One of the last of New York's cigar-store Indians. It was the American Indian who introduced smoking to the white man

The Strange Power of the Tides

Facts about the forces that bind the moon to the earth and the earth to the sun

By Philip Schwarzbach

Just as a magnet draws up steel filings, so the moon pulls up the waters of the earth, causing tides

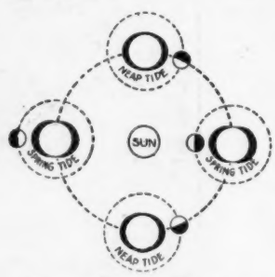
WHY does rain fall downward? And why does a man who jumps out of a window drop downward? Why, in short, do things always fall to earth when released in air? Sir Isaac Newton asked himself these questions—but not, as is popularly supposed, because an apple bounced off his head. That apple is almost as famous as the apple that Eve fed Adam, but we fear that it never existed. Newton needed no inspiring bump to come to the conclusion that every body in the universe has an invisible power over every other body—the power of attraction. This power pulls the rain down to the earth, pulls the waters up from the earth, causing what is known as tides, and binds the moon to the earth, the earth to the sun.

Why the Moon Does Not Fall

The universe is held fast by this great mutual attraction, gravitation. And why does an apple actually fall, whereas the moon remains at a constant distance from us? Newton tells us why in his laws of gravitation: two bodies attract each other directly as the product of their masses and inversely as the square of the distance between them. The power that one body holds over another body depends both on its mass and its distance from that other body. The bulkier it is, the greater its power, but if it is far away, that power diminishes rapidly. The very small apple succumbs promptly to the pull of the near earth, whereas the larger and more distant moon is not so easily influenced and holds her own at a fixed distance from the earth.

Tides are the outward and visible sign of the attraction of the sun and moon for us and us for them. The solid earth tries to rise, but doesn't succeed very well. Still, there are regular tides in the earth's crust—small ones. We never see them as we do the water tides. This constant rise and fall of the earth's crust causes variations in the pressure underneath. It is very probable that the solid tides contribute to volcanic eruptions.

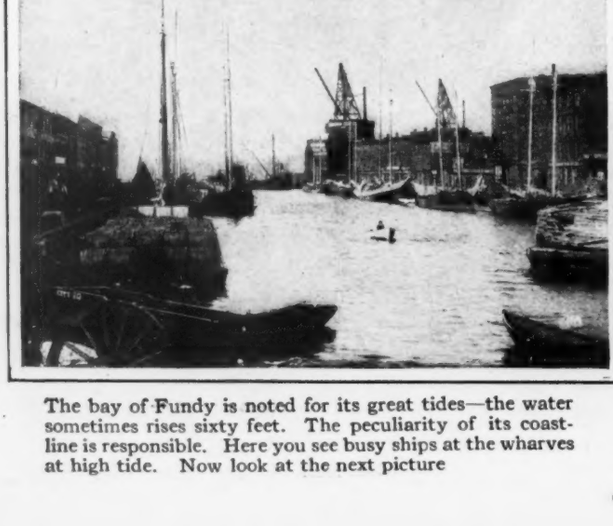
Water is molecularly easier to influence than a solid, and so it responds to the pull of the sun and moon by rising when they approach. Just as a magnet attracts filings, so the moon pulls up the waters of the earth. But the moon's passage affects water much more than does that of the sun, and Newton's law tells why. Though the sun is much larger than the moon, its very great distance from us is outdone by the small moon's nearness. As they revolve, earth, moon, and sun are sometimes all in the same straight line and at other times at angles with each other. With both the sun and the moon pulling on us, sometimes together and sometimes from different directions, the resulting tides are bound to vary.



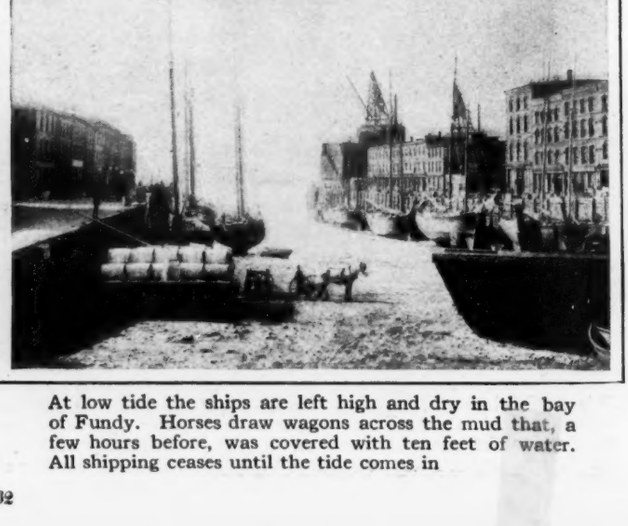
Sun and moon pull on the earth. When they pull together, the resulting tides are known as spring tides. When they pull at right angles with each other, the resulting tides are called neap tides

When in a straight line, sun and moon pull together and cause the tides to rise very high. We then have what is known as spring tides. But at right angles the sun and moon are working against each other, and the resulting pull is not very great. Then low tides are comparatively high and high tides are comparatively low. These are known as neap tides. The intermediate tides vary accordingly.

What about the water on the other side of the earth when the moon is pulling it up on this side? We might naturally think that all the water was pulled from there to make the high tide here; but that is not the case. They have their high tide at the same time we do, and this is the reason: the waters under the moon are not alone in their agitation. The earth, too, is drawn toward the moon and



The bay of Fundy is noted for its great tides—the water sometimes rises sixty feet. The peculiarity of its coastline is responsible. Here you see busy ships at the wharves at high tide. Now look at the next picture



At low tide the ships are left high and dry in the bay of Fundy. Horses draw wagons across the mud that, a few hours before, was covered with ten feet of water. All shipping ceases until the tide comes in

away from the waters on its opposite side. This causes these opposite waters, which are but little affected by the moon apparently, to swell up into what is known as an opposition tide.

If the earth were absolutely round and completely covered with water, tides would be unhampered and therefore uniform in height. But islands, continents, varying depths of oceans, rivers, bays, and all local peculiarities greatly affect tides and cause them to vary in height. The water is forced into some places and out of others.

A Sixty-Foot Tide

Bays can boast of the queerest tides of all. At Eastport, Maine, which is near Passamaquoddy bay, the rise is sometimes twenty-six feet. You might easily ferry from Lubec to Eastport, get off the boat, come back in a few hours, and find the boat gone—not really gone, just dropped from sight behind the dock by the swift outgoing tide. But much worse things might happen in the bay of Fundy, where tide-rise is sometimes sixty feet. When this sixty-foot tide goes out, all ships anchored or docked in sixty feet of water are stranded high and dry.

Because of the inconveniences that tides cause, it is well to know in advance the times and heights of future tides. And since all prediction is based on known facts of present and past, tide-gaging is necessary for tide prediction. The easiest way to measure tides is to sink a pole in the water and see how far the water rises and falls on it. But every tide-pole must have a constant attendant to make records of fall and rise, and then these records are sure to be inaccurate because of wave motions.

This led to the invention of tide-gages, which keep their own record and are so situated that wave motion is eliminated.

A well is dug on shore to a depth of several feet below the lowest tide in the vicinity. A pipe is run out into the sea through which the water enters the well. Inside the well a copper cylinder is floated. A wire fastened to the top of the float runs up to the top of the well and passes round a wheel. Thus, as the water in the well rises and falls, the wheel turns backward and forward. This wheel motion is imparted to a pencil attached to the wheel. As the tide rises and falls, the pencil draws a curve on a paper wrapped around a drum that revolves once in twenty-four hours. At each complete revolution of the drum a tide-curve for a day is registered.

Since high tides happen an hour later each day, no two curves will interfere with each other and the gage can be operated for several days before the paper need be removed.

Because of the inconveniences tides cause, tide prediction is very useful. With this predicting machine you can tell when the tide will rise and fall

The curves recorded are interpreted in terms of feet.

These tide-curves are carefully studied and then carefully resolved into the elements that caused them. Prediction is simply recomposition of all these elements.

Tide prediction, thanks to Lord Kelvin, is now done by machinery. Actual mathematical calculations are complicated and tedious. In Lord Kelvin's machine each element is represented by a pulley that contains an adjustable pin. All the pulleys are connected by a cord which, as in the case of the tide-gage, terminates in a pencil that draws curves on a revolving drum. When predicting a tide-curve for any particular place, at any particular time, all the pins are set to represent the peculiarities of that place (this information was obtained from tide-gaging), and a large crank is turned. This sets all the pulleys in motion, and the resulting motion is imparted to the pencil that draws the curve on the drum. In this way tide-tables are compiled.

This is a tide-indicator. A floating block is connected with the pointer, and as the block goes up and down the pointer moves backward and forward

Putting Tides to Work

For bathers we have tide-indicators. These are stationed along the shores and register tide-rise with a floating block, as in the case of the tide-gage. But this block is connected with a pointer instead of a pencil. The pointer moves back and forth on a large scale that is visible for a great distance.

There are some thrifty folk who would make the tides pay for all the trouble and expense they cause us by putting them to work turning water-wheels. The rising water is impounded in a reservoir, and then as it falls it is forced to turn a water-wheel in order to get out. But since it takes twelve hours for the tide to rise and fall, the work done this way is usually not worth the cost of the machinery needed to run a tide engine.

Other hopeful ones have made the tides work a piston up and down. A platform on which a cylinder is mounted is anchored to the bottom of the sea. Inside the cylinder is a movable piston, which moves up and down twice a day with the tide action. Again not enough is accomplished to cover expenses.

But the tides really do work, in their own quiet way, clearing up shores, scouring river-banks, and performing other lowly tasks.

Now, work cannot be done without the consumption of energy. Where does all this tidal energy come from? The earth itself. And what is the source of the earth's energy? Its rotation. But as this energy is drawn from the earth it is not replaced, and the startling result is that our rotation power grows weaker. And very g adually the earth is slowing up and our day is increasing. Do you realize what that means? At some very future date the day will be equal in length to our present year, the time it takes for us to revolve around the sun. Then one side of the earth will be sun-baked all the time and the other half will be in total darkness. Fortunately for us, that day is very far off.

Truing Up Crankshafts

USUALLY, truing up an inaccurate crankshaft in a lathe is a long and costly job, requiring several hours. By the aid of a new tool the pins on a crankshaft may be turned up true within one hour.

The shaft is mounted between centers on a lathe in the usual manner. This tool is then adjusted to take the proper cut and placed on one of the pins.

The lathe is next set in motion. The tool continues cutting until the pin has been reduced to the proper diameter.

This process is followed out with each one of the crankpins.

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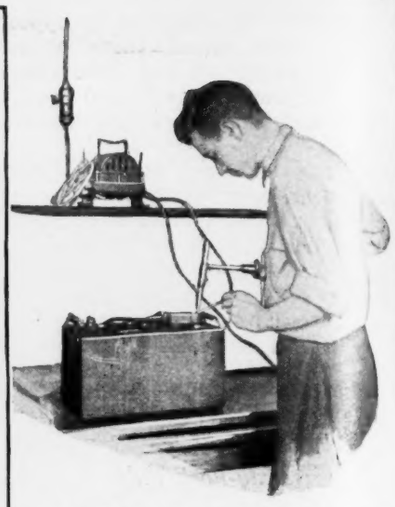
How Denmark Follows the Election Returns

THIS huge electric sign or bulletin-board is mounted in the front of a newspaper office in Denmark. It was used to announce the results from outlying districts of a recent election.

Each of the candidates in the various districts has a colored light that represents his party.

When a candidate wins in a certain district, the light representing his party is flashed on. A moment's glance at the electrical bulletin is all that is required to determine the way the election is progressing.

Election returns in the United States are usually given out by the newspapers in a different way. They are generally flashed on a large screen by the use of a powerful projecting machine. This method informs the public to just what extent a certain candidate is winning or losing and if their favorite stands a chance.



The Right Way to Melt Lead

LEAD-BURNING requires the hand of an expert when a gas flame is used. With the little electrical tools pictured above, however, anybody can make repairs on lead parts.

A carbon electrode is used. An arc is drawn between the lead and the carbon electrode. The heat generated is sufficient to melt the lead readily.

The hot carbon of the electrode reduces the lead oxide as rapidly as it is formed. This prevents the lead from burning to an oxide, since the carbon has a greater affinity for the oxygen of the atmosphere.

A transformer produces a heavy current from the electric-light socket.

A Railroad Repair-Car

WHEN a freight-car develops a broken wheel or a bent axle or any other serious ailment, it usually happens far away from home. But the new repair-car below will cover the distance between the two and do the repairing on the spot where the accident occurred.

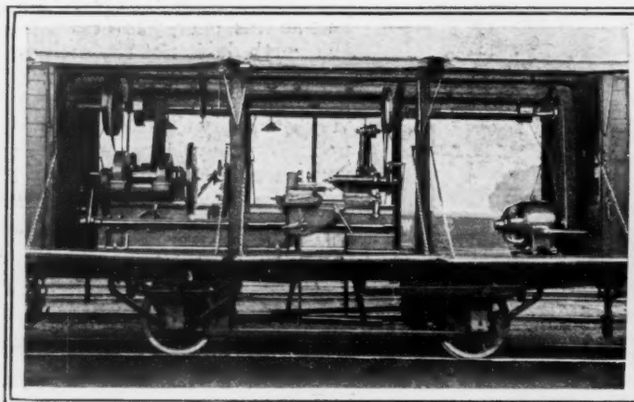
This repair-car is equipped with machinery for all kinds of work. There is a screw-cutting lathe, a drilling-machine, a shaping-machine, work-benches with vises, portable forges, and anvils. A fifteen-horsepower motor furnishes the power for the machinery.

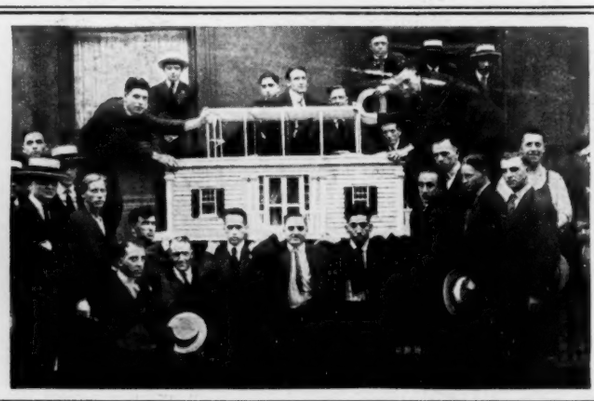
The sides of the car open outward, and are used as a working platform. Chains hold them level with the floor of the car, and a workmanlike traveling repair-car is the result.

Over Niagara in a Houseboat

SOME people demand more thrills in their existence than ordinary living furnishes. That is why an advertisement calling for some one to attempt a trip over Niagara Falls in a houseboat was answered by one hundred and thirty-five men.

Below are some of these would-be adventurers posed around the houseboat that is to serve as the vehicle to convey one of them over the falls. The amount of money offered for this dangerous exploit is only one thousand dollars. Who offered the thousand? A motion-picture director who wanted to make a real "thriller." If so small a sum were offered for a task demanding mental effort equivalent to the magnitude of the adventure, it is doubtful if as many as one hundred and thirty-five men would offer themselves.





"Did You Forget to Mail That Letter?"

HOW many people walk by the letter-box every day and forget to mail the letter that was supposed to have been mailed at the first opportunity?

A postmaster once gave a lecture to a large audience and began by mentioning the letters that people had forgotten to mail and which had brought many inquiries to the department. Many in the audience hurriedly reached into their pockets and brought out their forgotten letters, and every one laughed. But here is an idea that at least helps the memory of the people who pass a certain mail-box.

Walking through Fire Safely

FIRE-RESISTING chemical solutions are rapidly coming into general use. In time it is possible that everything will be given fire-resisting treatment by sodium silicate or some similar chemical.

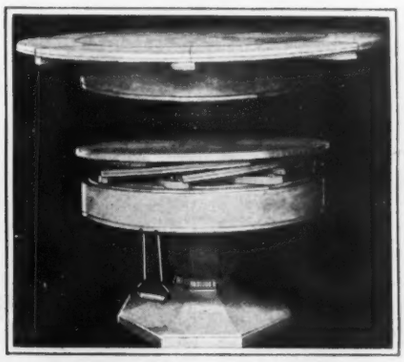
The picture below shows a man walking calmly through blazing shavings saturated in kerosene. He is wearing a khaki uniform, boots, and headgear—all of which have been treated with the fire-resisting solution he invented. The man is an Englishman named Truro who was recently discharged from the army.

Casters for the Water-Bucket

A BUCKET of water may be too heavy to be lifted or carried about the room when the scrubwoman is not physically strong.

To help persons who are lacking in normal strength, a roller support for the bucket has been invented by a citizen of Leipzig, Germany. This idea solves the problem of transporting the heavy pail without injury to the health of the worker.

The metal base of the bucket is provided with three rotatable casters, held in place by three set-screws. The screws are long enough to make it possible to use the same base for buckets of different size.



A Round Table that Folds

IN these days of small rooms, collapsible furniture is coming more and more into use. From Germany comes a folding round table.

The center part of the table-top is a single piece of wood. But around the outside there is a series of extension sectors that fit together and enlarge the working surface of the table.

These sectors are so connected that they will fold like a fan and fit beneath the table-top when any one of the supports below them is pulled. There is a lever that will conveniently raise and lower the table-top. Thus, when you wish to reduce the size of the table, you raise the top and make room for the sectors below.

Replacing Glass Windows with Brick

PROSPERITY is heralded by glass show-windows; the greater the prosperity, the larger the window. But glass has become very expensive in Europe since the war and most of the merchants are not prosperous enough to pay the price.

In the picture above you see workmen replacing a large glass window-pane that had been broken. Instead of putting in another pane of equal size, they built up the lower part of the window with bricks and then filled in the top with small panes. From the signs at the sides of the window you can tell that this shop is in Germany.

Baby Rides on Mother's Head

THE native women of Orange Free State, South Africa, carry their bundles and their water-jars on their heads, so it is not astonishing that they should carry their babies in like fashion.

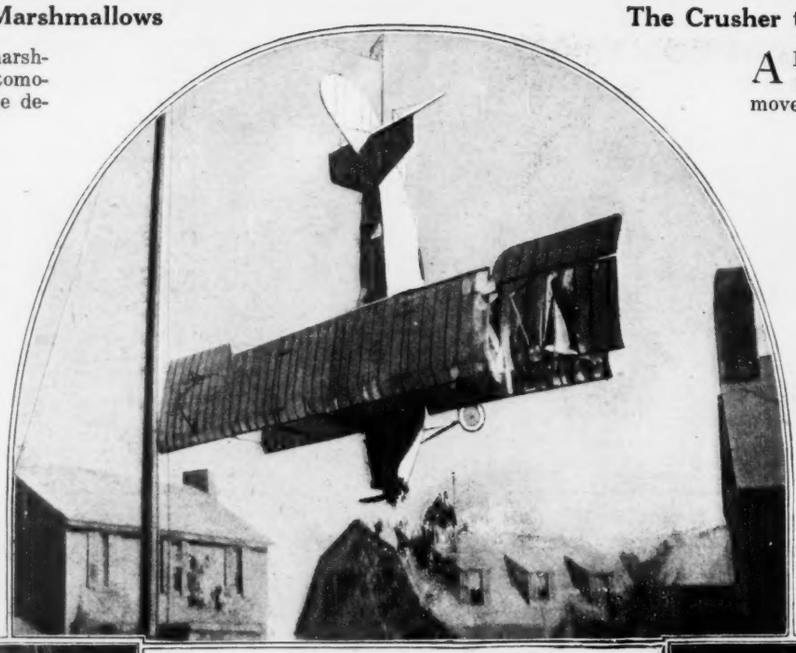
Baby is deposited in a *chihungju*—a sort of basket that can be turned upside down and used as a hat when the baby is old enough to walk. The mothers usually try to put the babies to sleep before they start out, and so insure a better balance.

Mend Leaks with Marshmallows

CARRY a tin of marshmallows on long automobile trips. Should a hole develop in any of the gasoline pipes, a marshmallow will fix it.

The sugar and gum arabic in the marshmallow will not dissolve when brought in contact with gasoline. Thus the marshmallow can be wrapped around the hole and fastened in place with tape, as shown in the picture below.

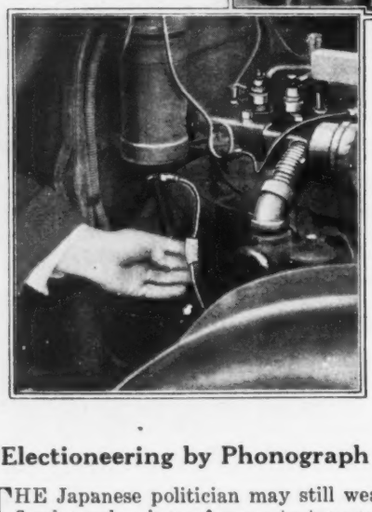
When the R-34 came over from England, the entire crew had to chew chewing-gum until it was soft, in order to mend a leak, and they succeeded in stopping the leak in that way.



The Crusher that Did Not Crush

A HUGE iron ball weighing nine thousand pounds was moved until it hung directly over a sheet-metal roll twenty inches in diameter. At a given signal the ball was released by an electromagnet and it fell through the thirty feet that separated it from the roll. Its job was to crush the roll.

When the ball hit the roll, instead of crushing it, the ball remained poised in perfect balance on top of the roll. And it stayed that way for twenty-four hours. It would have remained poised indefinitely had it not been needed elsewhere.

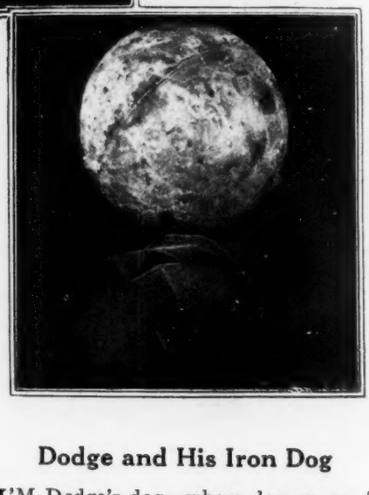


How Airplane Accidents Are Staged in the Movies

ENVELOPED in flames, the airplane crashes to earth, and the villain in the cockpit is burned to a crisp. You utter a sigh of relief as the next reel starts, and then you begin to wonder whether the villain really did make that drop. It seemed so real.

Here's what happened, without a doubt. A dummy airplane, exactly like the one in which you saw the villain flying a few minutes before the crash, was hoisted—tail first—between two tall poles. Chemicals fastened to the nose of the machine were then set on fire. At the signal "Camera!" the cable that held the airplane suspended was released, and the flaming dummy airplane, with a dummy pilot in the cockpit, crashed to earth.

The camera-man, grown callous through constant repetition of such "thrillers," calmly turns the handle.



Electioneering by Phonograph

THE Japanese politician may still wear flowing robes in preference to trousers, but he is Americanized when it comes to campaigning.

He makes speeches on street corners and into a phonograph horn, quite in the manner pursued by candidates for the Presidency in the United States. Many phonograph records are made of these speeches and distributed among the voters.

Dodge and His Iron Dog

"I'M Dodge's dog—whose dog are you?" With these words painted on his side, a ferocious iron bulldog challenges the world as he stands outside his master's store.

Passing bulldogs are utterly indifferent to him. Customers, however, remember Dodge and his bulldog whenever they want to buy or sell a sewing-machine, a piano, or any of the things that Dodge deals in.

Wanted: Radium for the Treatment of Cancer

ESTIMATES show that to take care efficiently of the cancer cases in the United States one gram of radium element would be required for one million population. This means that there should be available for hospitals about 110 to 120 grams of radium. Of this amount not more than about twenty grams are in the hands of institutions. It would require from ten to twelve million dollars to buy the radium needed.

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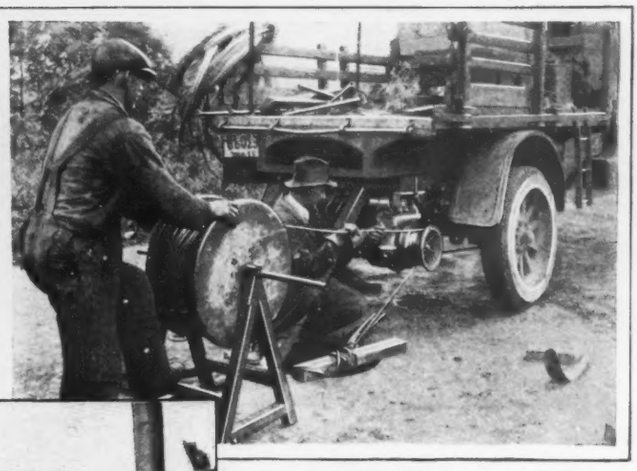
Play the Phonograph with the Finger-Nail

SHOULD you run out of phonograph needles sometime when it is inconvenient to buy more, try this. File the nail of your forefinger to a slightly sharpened point, and fit it into the groove of a moving record.

The record will be reproduced very faintly, though accurately. The best way to hear it will be to lay one ear against the hand. In this position even the words of a song can be heard.



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Steering a Motorcycle with the Feet

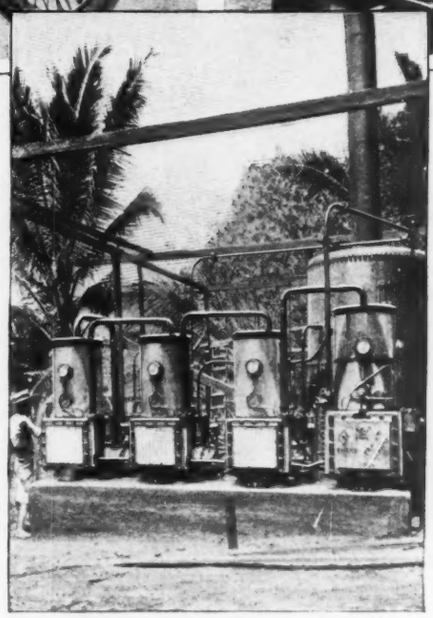
A FOUR-WHEEL motorcycle capable of climbing a grade of nearly thirty per cent to the mile at the rate of sixty miles an hour is no mean machine.

The motorcycle that does this is built with steering controls somewhat similar to those of an airplane, with cables and pulleys of great strength.

A six-horsepower engine to drive the car is placed in the rear instead of in the front.

The hollow "radiator" accommodates the pilot's legs. The forward part is streamlined to reduce head-on resistance to the wind.

For speed and hill-climbing this "spider" motorcycle is supreme, and will give joy to the heart of the maddest speed maniac that ever made human beings and live stock flee for their lives.



Stills on an Island—But for Water

FRESH water is a big problem on a tropical island, queer as it may seem to us who have plenty of it. The plant shown above is used in distilling sea-water. The distillation, of course, eliminates the salt and makes the water fit for drinking.

Four independent stills make up the plant. These are operated by the big steam-boiler shown in the background. The boiler is supplied with fresh water, and this eliminates the trouble caused by the use of salt water.

The plant here shown supplies all the needs of a fairly large sized island. It has a distilling capacity of several thousand gallons a day.

How Cables Are Pulled through Conduits

WHEN one man has the job of pulling against a weight of five thousand pounds with a wire rope seven sixteenths of an inch in diameter, he can truly be said to hold a superman's job. Yet this is what the man who lays the heavy telephone cables in the street conduit has to manage.

To perform the task, he makes use of an "underslung winch," attached to the rear under side of the frame of a motor-truck. The machine is connected with the power transmission of the truck, and is governed by the speeds of the truck. One man can operate the apparatus.

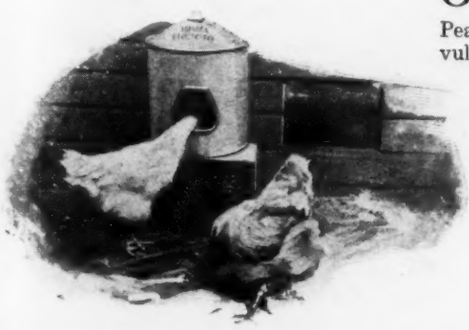
It is so sensitive that the operator can tell immediately by the "feel" whether or not any obstacles are being met. This prevents the possibility of damage being done to the cable by sharp objects in the duct.

Keep the Water Cool for the Hens

SINCE eggs contain seventy per cent water, it would be wise to cool the hen's drinking-water to render it more tempting. More water, more eggs.

In the picture below you see a drinking-tank for the chickens that is built on the vacuum-bottle principle. The water that is placed in it retains its original temperature for a long period. In the summer time ice-water is placed in the tank in the morning, and it remains cool all day. On the other hand, in freezing weather warm water may be poured in it, and even at the end of twenty-four hours it will not have frozen.

The tank should be placed so that it is at least six inches from the ground. This precaution will tend to keep the water in the tank free from dust and dirt.



A New Process of Vulcanizing

ONE of the members of the Manchester Institute of Technology, Mr. S. J. Peachy, has discovered a new way to vulcanize rubber. He exposes it alternately to sulphur dioxide and hydrogen sulphide. This treatment causes the rubber to vulcanize rapidly even at room temperature.

The gases used can be generated cheaply, and they are used under small pressure. The advantage of this system is the elimination of heat.

Feed the Pup from a Cake-Tin

IF you ever grow tired of angel-cake and decide not to bake it any longer, use the specially constructed baking-tin as a feeding-dish for the family puppy. The tin is deep enough to hold plenty of milk without spilling.

Drive a long peg into the floor and slip the tin over it. This will prevent the tin from going wherever the puppy wants it to; yet he can amuse himself by the hour swinging it around on its peg axis.

The puppy below is a very young one, and he is always seen in the vicinity of his feeding-dish, which is quite out of the way under the washtubs.

When the puppy grows older and demands food that is more solid than milk, the angel-cake tin can still be used.

No Stones Will Clog This Irrigation Pipe

PIPING of all kinds has a great attraction for small boys. If the piping is large enough, the boys try to crawl through it; and if the piping is small, the boys satisfy themselves by hurling stones at it or stuffing all manner of rubbish into it.

One rice-grower in Arkansas was greatly troubled by mischievous boys, who persisted in clogging up his irrigation pipe. As a result, he made a special cover for the pipe. Now when water is not being pumped up to the irrigation ditch, the cover is fastened down with a padlock.

The pump that supplies the ditch with water is located below the ground, so that with the protecting padlock, the farmer thinks he has defeated the machinations of mischievous boys.

Jobs Advertised on the Fence

NOWADAYS we all know that it pays to advertise, but it costs money to do so. There are many small German manufacturers who can no longer afford to pay the advertising rates charged by the magazines and newspapers. Yet they wish to tell the rest of the community what they have to sell. What can they do?

They have solved the problem by pasting their "ads" on fences. They pay the owners of the property on which the fences stand a small sum for the privilege. These advertisers are at a disadvantage in that the "ad" appears only in one spot.

Do people stop to read these advertisements? The picture below answers the question.

© Keystone View Company

The Filipinos Iron Clothes with Their Feet

IN the Philippines many of the women do their ironing with their feet. They place a slightly grooved board on the ground, fold one end of the garment to be ironed around a wooden roller, and place it in the groove. Next comes another board and then the woman's feet.

She stands on the board and holds on to any convenient support. If she has any children, they add their weight to hers, clinging precariously to their mother's body.

She sways her body back and forth, thereby rolling the roller and flattening out the creases in the garment that is wrapped around it. The process is a very slow one, and she and her children are forced to dismount often in order to readjust the garment on the roll. This process is more akin to the old-fashioned mangle than the modern electric ironer.

Here's a Slit Mitt for the Mechanic

MOST mechanical workers have tried both mitts and gloves, and found neither highly successful. The mitts are clumsy; the gloves enable them to handle their tools well, but they restrict the action of the fingers.

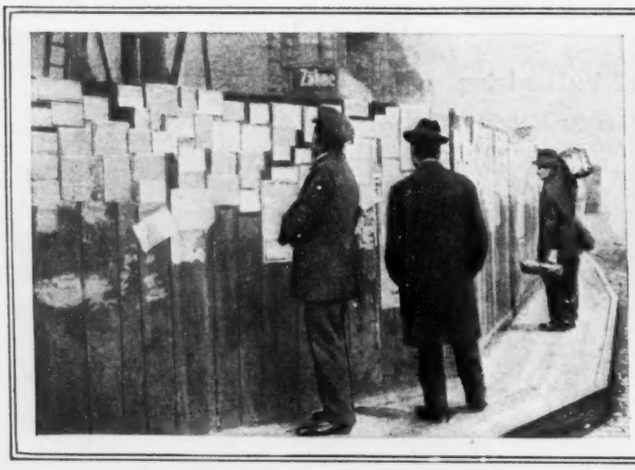
How can the merits of both be combined? The new glove, invented by James Carmean, of Kansas City, Missouri, is shaped like a bag and has a draw string at the wrist, but it is provided with several holes and slits through which tools can be thrust. Thus you can grasp them directly with your fingers without suffering any discomfort.

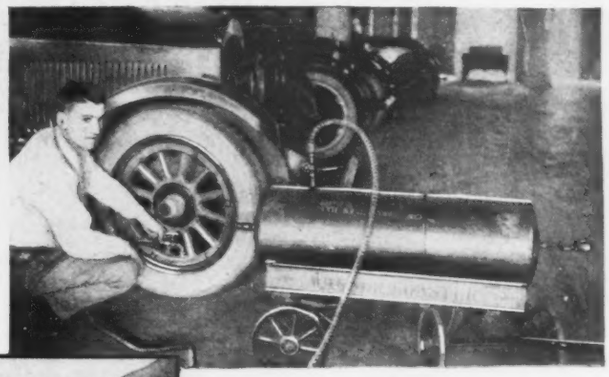
A few necessary stitches divide the fingers in pairs so that they won't get in each other's way.

Tightening Wood Paving-Blocks

THE task of tightening the wooden blocks in 7500 square yards of loose pavement was formidable. Taking up the blocks alone would have meant an expense of about $10,000.

The job was accomplished economically by a plan devised by John Richards, block-paving superintendent of St. Louis, Missouri. Strips of the pavement were cut out, and four-by-six-inch timbers were placed on each side of the opening. Steel jackscrews were inserted between the timbers. When they were manipulated with a wrench, the blocks on each side, packed with a new pitch filler, were squeezed compactly together. The opening was then repaired with other blocks.





Look Front as You Row

ROW in the ordinary way and you can't see what is ahead of you. This inconvenience is overcome in a new type of oarlock.

The ordinary oars are cut in two pieces, and each piece is fastened securely into the special oarlock. When the handle is pulled toward the body, the rower sends the draft forward.

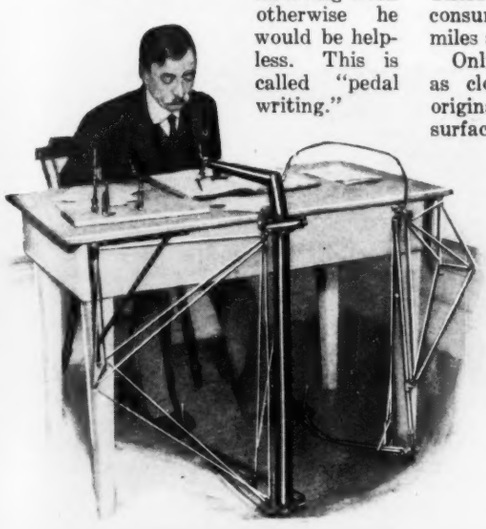
Each section of the oar is joined by a metal lever bar which works upon pivots to reverse the motion of the oars. This enables the man at the oars to see where he is going by making it possible for him to face the bow of his boat. Any one who has had rowing experience knows what a lot of pleasure is lost by the necessity of continually turning around.

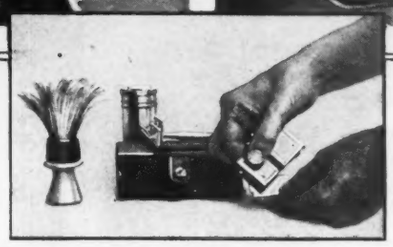
He Makes His Feet Do the Work of His Lost Arms

WRITING a letter without the use of his arms is what the man in the picture below is doing. In place of his hands and arms he is using his feet.

This is made possible by a carefully arranged system of levers which he manipulates. A man can also draw pictures by the use of this ingenious device.

The end of the lever on the table can carry either a fountain-pen or a pencil. It requires considerable practice to become skilful in the manipulation of this device, but once the operation is understood, a means is provided for a man to earn his living when otherwise he would be helpless. This is called "pedal writing."





Drying the Safety-Razor Blade with a Pad

INSTEAD of cutting fingers and towels in drying the safety-razor blade, use a regular drying-pad. It consists of a brass clip holding at one end a strip of rubber and at the other end a pad of cotton. Razor-blades are run through the rubber strip and then through the opposite cotton pad.

The surplus moisture is wiped off by the rubber, and the rest of it is removed by the cotton. As the blade is pulled through, the clip is pressed down on it, and all danger of the blade's rusting is avoided.

Interesting Facts about Meteors

A "METEOR specialist," W. F. Denning, F.R.A.S., has recently announced some interesting facts about those curious bodies that sometimes fall into our atmosphere and are destroyed.

Contrary to former opinion, he asserts that meteors do not become visibly luminous at altitudes above ninety miles, and the average height at which friction with the air sets them aflame is seldom greater than between seventy-five and eighty-five miles. These bodies, the swiftly moving ones, are consumed at from fifty-five to forty-five miles above the earth's surface.

Only the slowly traveling meteors come as close as twenty-five miles. A few originally large bodies have reached the surface as partly consumed, fused masses.

Meteors of the swift variety, such as those having their radiant point in the constellation Leo or Perseus, have never been known to reach the ground.

Meteors that come to us "head on," of course, cut a swift path through the atmosphere, and are more quickly consumed than those that overtake the earth in the flight through space.

A Toy Wagon Goes to Work

THE owner of a certain garage wanted to provide his air-tank with wheels to make it portable.

Not wishing to go to the expense of having heavy iron wheels fitted to the tank, he decided to buy a boy's coaster wagon and place the tank on it. In this way he saved about fifty dollars and added to the efficiency of his garage.

The little wagon is strong enough to stand up for years under the light service that is required of it. Such a wagon will easily carry a load several times that of the tank.

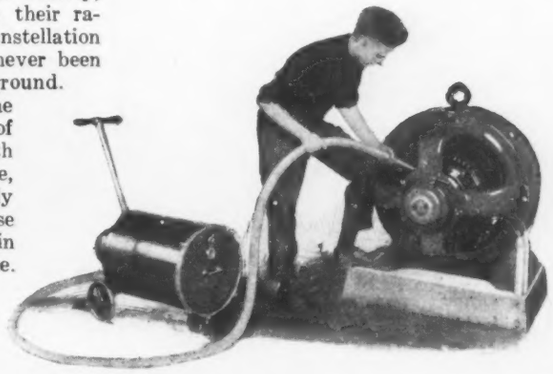
An iron strap passing around the tank and bolted to the bottom of the wagon, prevents the tank from rolling off when it is moved from place to place.

Portable Vacuum-Cleaners for the Machine-Shop

VACUUM-CLEANERS are playing just as important a part in the factory today as in the home. Machinery and electrical fixtures collect dust with great rapidity, and they are apt to function improperly if they are not given a thorough cleaning at regular intervals.

In the illustration below you see a powerful vacuum-cleaner that is used for this purpose in several large factories. It is mounted on rollers and in spite of its weight, can be moved from socket to socket with ease. The juice from any ordinary socket is sufficient to turn over the motor that gives the cleaner its power.

If you don't wish to buy a special vacuum-cleaner for your factory machinery, you might use the ordinary one that is used for cleaning rugs.



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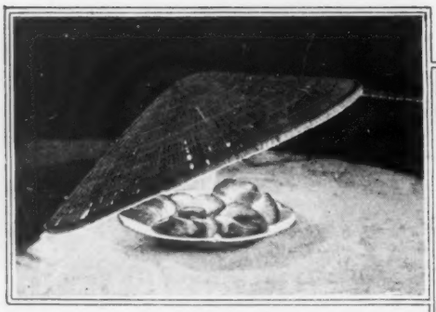

If you have a small lamp with a basket-shaped shade, you can place it over the plate of hot biscuits and let the heat of the lamp keep them warm

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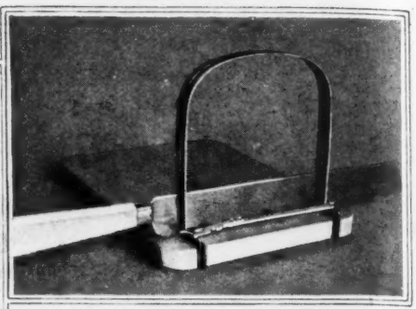

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Boot-trees joined together so that they will hang on a door have been invented by Bertha Clark of New York. Thus the shoes are kept out of the way of dust

Phonograph needles will remove all the particles incrusted on the inside of a milk-bottle. You fill the bottle with soapsuds, throw in a dozen needles, and shake the bottle vigorously

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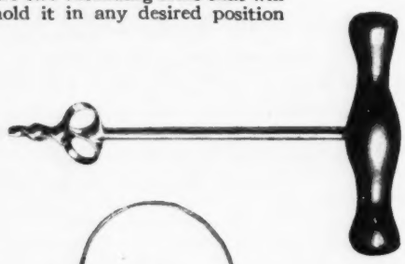

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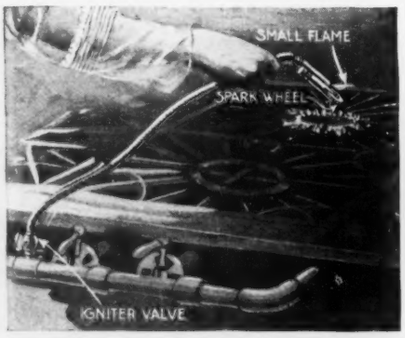

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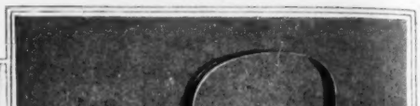

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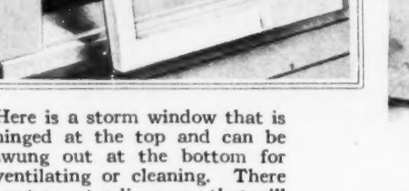

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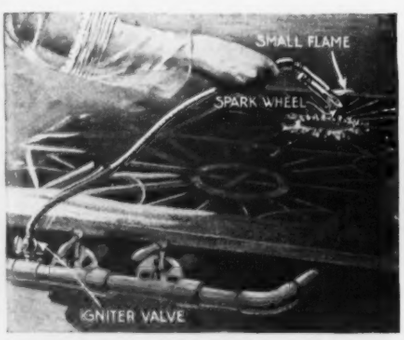

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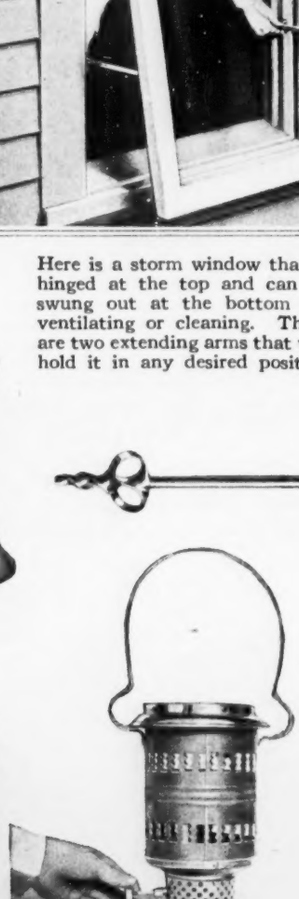

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together and kept in everlasting motion by enormous electric forces. These forces will be the source of energy of the future, provided we succeed in discovering the secret of breaking up the atoms. In radioactive substances, this breaking up takes place continually without outside aid. The nuclei of radium atoms send out alpha rays, consisting of helium atoms, and beta rays, consisting of electrons. It is estimated that the dissociation of one gram of radium produces 170 gram-calories every hour, which equals for the entire life-period of radium 4,000,000,000 calories.

Europe Takes to the Air

DURING the past year 1325 airplanes have arrived in England from European countries and landed freight and passengers. Of these machines 1097 were British, 236 French, 9 Belgian, and 1 Swiss.

In Germany and Holland great plans for aerial transportation are being made. One can fly from London to Paris in less than three hours. By rail and steamer it takes all day to make the trip. Passenger fares are but little more than twice as much by air as by the rail-and-water route, while light freight is actually cheaper sent by air.

Mankind and the Sea

IN the course of the twenty-four hours of the day, the temperature of the human body changes.

This temperature is about 99.3 degrees F. at four o'clock in the afternoon; but it is only 97.2 degrees between two and six o'clock in the morning, a variation exactly similar to that which the waters of the sea undergo, influenced by the rays of the sun, in the interval of a day.

Those who believe that man evolved from some sea organism cite this curious fact as evidence of a kind. If the marine origin of man is accepted, the cell that ultimately became the nucleus of the human structure assuredly had to adjust itself to the temperature of the water at the depth in which it existed. The ancient oceans were warmer than the sea of to-day, and their temperature was the same as that of the human body.

Electrified Tourmaline

THE crystal, tourmaline, has very remarkable optical properties, a fact known to most people. However, few people have heard of its peculiar electrical properties. Tourmaline is capable of attracting small bits of paper and straw in much the same way as amber. This attraction is, of course, due to an electrostatic charge.

When the crystal is exposed to sunlight of a low temperature, it loses its electrical charge, but regains it upon being heated again. If it has a negative charge at first, it will have a positive charge when it is reheated.

Several other precious stones exhibit various phenomena along this line, but tourmaline is the most interesting and spectacular of all.

Porcelain that Can Be Blown

PORCELAIN is seldom used in the manufacture of chemical and physical apparatus, because, after it is once formed, it will crack or burst when heated. Glass, on the contrary, becomes soft when heated, and can be bent or blown to any desired form.

Why does porcelain crack? Principally because the glaze with which the porcelain is coated does not expand at the same rate as the porcelain when heat is applied. There is considerable strain, and cracking or bursting results. Now, however, a European manufacturer has overcome this difficulty by producing a glaze that has the same coefficient of expansion as porcelain. Both are highly resistant to changes of temperature.

Loud Sounds Travel Fastest

THE noise from a ten-inch gun will travel much faster for a certain distance than noise or sound of a lower magnitude. This was recently proved by Dr. Dayton Miller, of the Case School of Applied Science. The sound of the explosion from one of the big ten-inch guns travels at the rate of 1240 feet per second for the first hundred feet. This speed proves to be exactly 22 per cent above the normal travel of low sounds.

At a distance of two hundred feet from the source the speed of the sound is only 5 per cent above normal. Above five hundred feet the velocity of the sound from a big gun falls back to normal.

Do You Have Dream-Germs?

"CLOSE your eyes and you will see curious color blotches, dull or vivid, flashing upon a gray or black background," says Professor Henri Bergson. The spots shrink and spread, in waves of shifting form and tone, slowly moving or swiftly flashing beneath the closed eyelids. "Phosphenes," "light-dust," or "ocular spectra," they have been called.

They are probably caused by the ever-varying modifications that occur in the circulation of the blood in the retina, or by the slight pressure of the eyeball upon the retina when the closed lid is pressed against the front of the eye.

That these spectra may be a stimuli for dream-pictures seems plausible. One investigator, gradually awaking with the dream-picture before him, watched it dissolve into phosphenes and melt into the colored spots perceived by the closed eyes.

The circulation of blood in the closed eyelid may also make images that serve as stimuli for dream pictures when a little light falls upon the eyelids.

5,000,000 New Homes Needed

THIS is truly the day of house shortage. At the present time there are 25,300,000 families in the United States. We have only 20,900,000 homes to accommodate these families.

Where do they all sleep? Many families live together under a single roof. Newly married people often make their home with their parents, waiting for the time when houses will be more plentiful and rents will be reduced.

A careful survey of the building situation in this country shows that we are eight billion dollars behind in our building program.

Asbestos and Its Uses

NEW uses for asbestos materials are being found every day. One of the latest is the use of asbestos twine in laboratories for binding together parts of apparatus that are exposed to fire or acid.

Asbestos is made up in many different forms. Besides twine, there is asbestos cloth and asbestos building material.

Fiber felts made of pure asbestos are used for insulating the heat-radiating surfaces of automobiles and for insulating electric wires.

Aid to Paper-Consumers

THERE has been so much talk of paper shortage in the past year that manufacturers from all over the world have suggested new ways of producing paper pulp.

Japanese manufacturers tell of pulp made from seaweed. The paper thus produced is used chiefly for cigarettes. In India bamboo is used. According to one of the government experts there, fourteen million tons of dry pulp can be produced each year from bamboo and the savannah grasses of Assam.

In our own country several experiments have been made. Down South, cotton fiber has been tried out by a large cotton company, and the manager claims that paper pulp of medium quality results.

One hundred pounds of pulp can be produced daily, and from it book paper, coated paper, and low-grade writing-paper can be manufactured.

Saw grass, which grows abundantly in the swamps along the Atlantic coast, can be turned into newspaper, it has been found. It grows so rapidly that two crops can be cut in a year. The cost of the grass is negligible, and thus pulp produced from it can be sold at less than half the price of spruce pulp. The resulting paper is tough and it absorbs ink well.

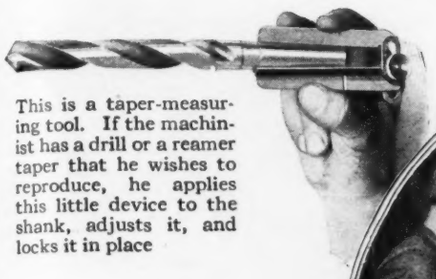
How Much Air to Burn Coal?

A POUND of pure carbon, which is the preponderant element in coal, requires the oxygen contained in 11.6 pounds of air to complete its combustion. But how much is 11.6 pounds of air? Imagine a column of air one inch square extending forty miles into the sky and you will have a good idea of the amount of air required to burn a single pound of coal. A pound of coal would occupy a column one inch square and only three feet high.

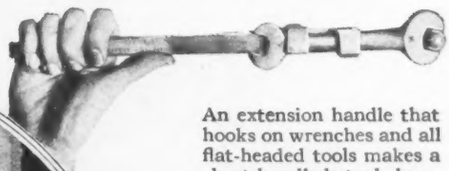
During the course of a single year, millions of tons of oxygen are used up in the combustion of coal. New York city alone requires many million tons of air to keep it warm during the winter-time.

Do It with Tools and Machines

This is the modern way and it saves time and money



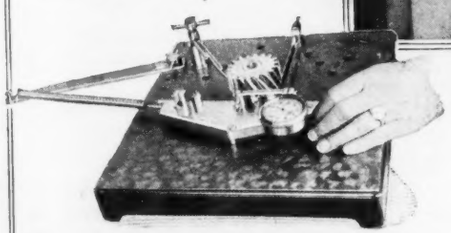
This is a taper-measuring tool. If the machinist has a drill or a reamer taper that he wishes to reproduce, he applies this little device to the shank, adjusts it, and locks it in place



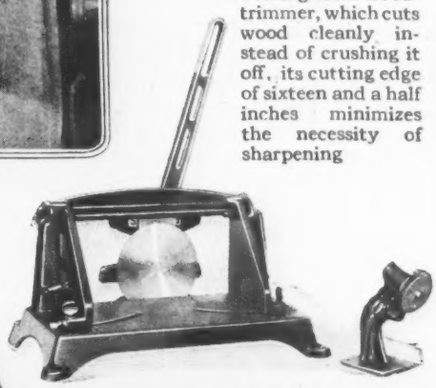
An extension handle that hooks on wrenches and all flat-headed tools makes a short-handled tool long, enabling the workman to reach corners not accessible to tools that will fit into the kit

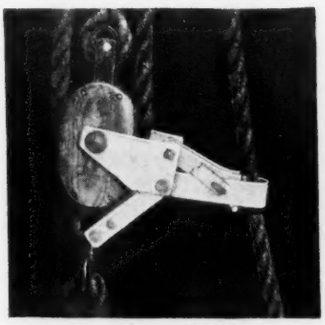
A specially made machine for finishing cylinder-head domes for automobiles so they will not collect carbon easily. The heads are roughed and finished and then polished

A tool that is used to inspect and check spiral and helical gears. The gage will register an inaccuracy of .0002 inch

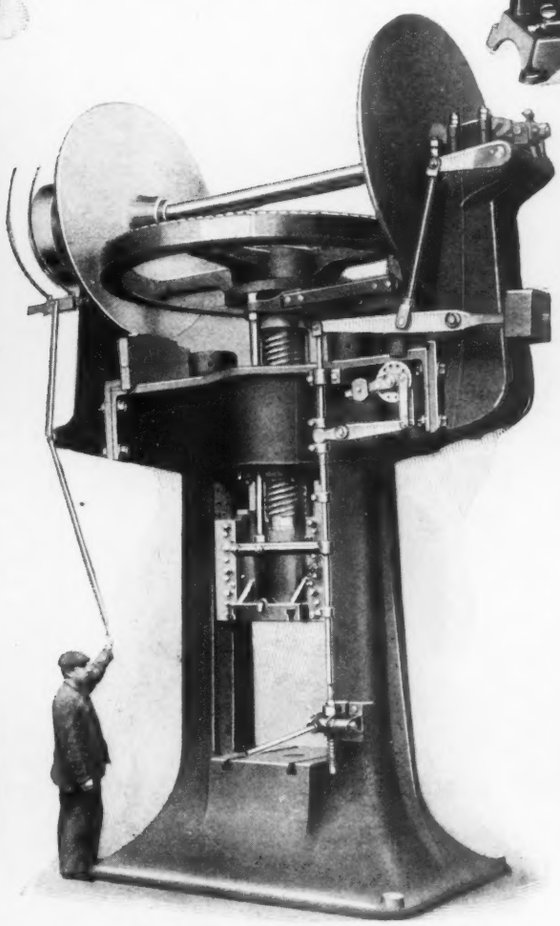


Very new is this revolving knife wood-trimmer, which cuts wood cleanly instead of crushing it off, its cutting edge of sixteen and a half inches minimizes the necessity of sharpening

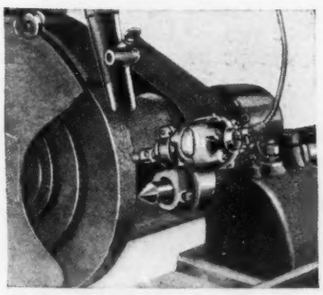




Safety for men working on scaffolds is the object of this rope lock, which grips hard the second the rope starts to slip through it. This will prevent a scaffold's falling before it has moved an inch

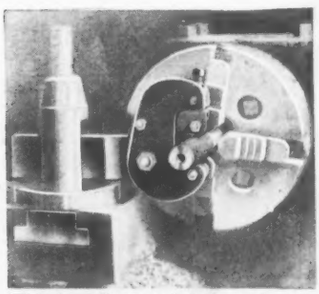


A grooved oiler, designed to lubricate the leaves of a spring efficiently, is inserted between the leaves, after the weight has been taken off the spring; the oil goes straight to the spot

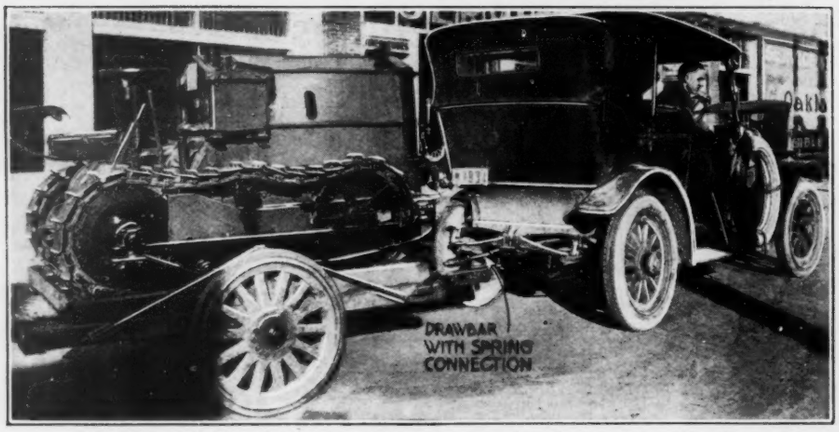


A machine that takes the place of a diamond tool in truing abrasive wheels; it consists of a motor, an abradent nib, and a holder; it is fed across the wheel to be trued, exactly in the manner of a diamond-pointed tool

Here is a huge press that squeezes a casting into the right shape. The pressure exerted is about 70,000 lbs. The big horizontal wheel in the middle is turned by vertical friction wheels



This knurling-tool, it is said, will do three times as much work as an ordinary knurler. It is not subject to the side strain that other knurlers have when the speed is increased, and it centers automatically after being set



A trailer for smaller dealers in tractors, for carrying the tractor to the farm. It is an old truck axle, a body framework, and a connecting drawbar

Taking Home the Farm Tractor

OF the two hundred thousand odd farm tractors sold in the United States last year, more than half were delivered by the local dealer to the farm of the buyer by some means other than their own wheels or creepers. This was the result of two causes: first, it is quicker and therefore cheaper; second, some of the tractors with cleats on their driving wheels cut up the average road.

While some of the larger dealers selling a great number of tractors have purchased trucks with special bodies for this work, the cost of the truck investment is too great for the smaller dealer, who sells perhaps twenty-five or fifty tractors a year. For such men the special trailer for this work shown in the accompanying picture will be of value. Most dealers use automobiles in their business, and by means of a small two-wheeled trailer the car may be used to make deliveries without any heavy investment.

The trailer may be made from an old truck axle with rubber-tired wheels, a body framework, and a connecting drawbar. The rest is easy. Load the tractor on the trailer, connect the latter to the rear end of the car, and make the delivery at the rate of fifteen or twenty miles an hour. The delivery made, the car may be used for its regular work without any change whatsoever.

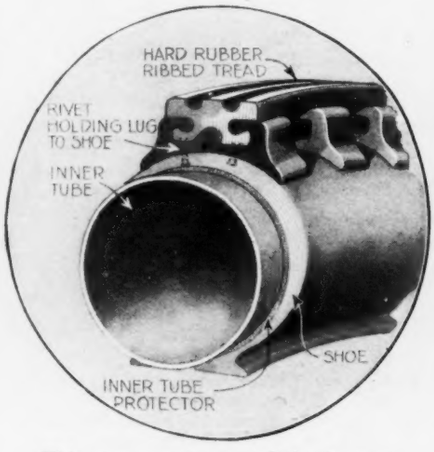
How to Prolong a Tire's Life

INVENTORS are always trying to devise some means of bettering the pneumatic tire and increasing its life. Every kind of substitution for air has been tried—springs, fluids, metals, fabrics, and fillers—all without success. While the ordinary pneumatic tire has a life of between five and ten thousand miles, the new type of tire shown herewith has a guaranteed life of twenty thousand miles. In addition to its greater life, the new tire is puncture-proof.

No attempt is made to eliminate the air as the cushioning property of the tire. Instead, the tread is made extremely thick so as to prevent punctures. It is thus really a solid tire placed around a pneumatic tire.

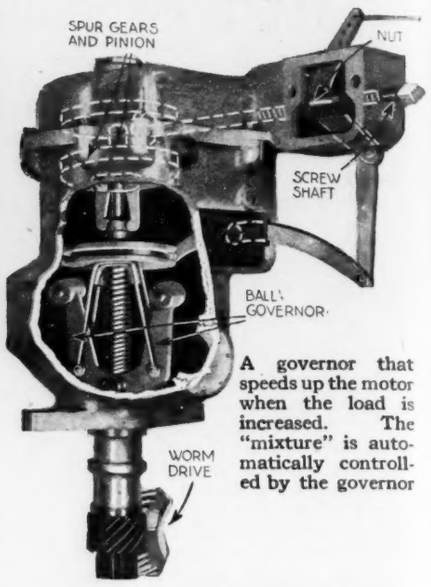
The manner of connection of the solid tread with the inner air-tube is most ingenious. First there is the inner tube, and around this a casing made of seven-ply wrapped fabric. Small metal lugs placed crosswise of the tread, with a movable hooklike joint in the center, are riveted to the casing and hold in place the hard rubber tread. These lugs are made of a special alloy, so that they are strong enough to resist severe shocks, and yet malleable enough to prevent breakage.

The rivets holding the lugs are of special composition, being non-conductors of heat, and rustproof. They are riveted by a special machine that puts a head on each rivet large enough to make it impossible for the rivet to work loose or tear away.



This new puncture-proof tire is guaranteed a life of twenty thousand miles

A Novel Governor for an Engine



A governor that speeds up the motor when the load is increased. The "mixture" is automatically controlled by the governor

A NEW governor for trucks, directly connected electric-power sets, or for marine engines is explained here. It can be made to govern more than one half per cent of the power, from no load to full load.

The main idea is that it at first governs excessively and then diminishes the governing action gradually, so as to meet easily the engine changes of speed.

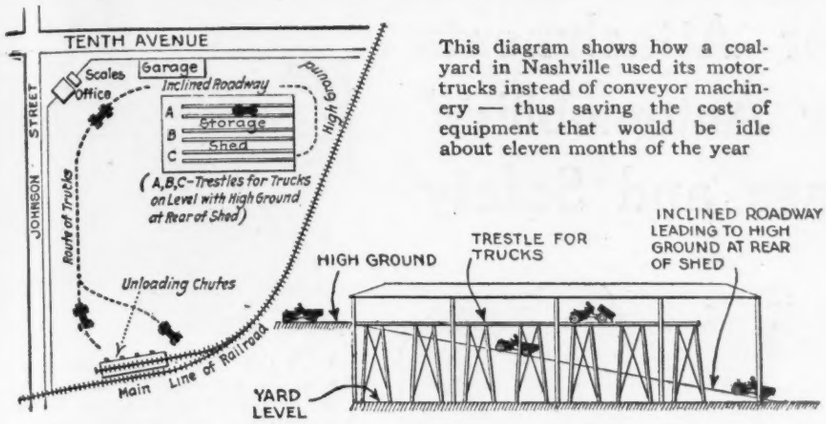
The governor has a vertical shaft driven from the base, and is protected by a metal housing. The lower half of this shaft drives a ball governor, operating to pull down a channeled collar, running freely on the shaft, against the spring. The slightest vertical motion of a pin held in the collar channel produces a movement in the fuel-adjusting pivot, by means of the connecting levers.

It is the top part of the shaft that carries the real governing mechanism. There are two spirals cut on the inner faces of the spool. The spool normally revolves freely on the shaft, driven by a supporting clutch. This clutch raises the spool when the speed is too low, and when it is too high the spool drops by its own weight below the normal position, except when a return spring is employed to give positive operation on horizontal mountings.

A spur wheel engages with the spiral in either the lower or upper inner face of the spool if the speed is disturbed. When the spur gear revolves, it does so in the plane of the shaft, which is at right angles with the plane of the illustration. It turns a threaded shaft so that the full-adjusting pivot is moved in opposition to the motion derived from the connecting levers.

As soon as the top part of the governor has cushioned the action of the speed control on the lower part, the rotation of the spur gear stops.

Using Trucks Instead of Conveyors



This diagram shows how a coal-yard in Nashville used its motor-trucks instead of conveyor machinery — thus saving the cost of equipment that would be idle about eleven months of the year

MOTOR-TRUCKS are taking the place of conveyor machinery in a coal-yard at Nashville, Tennessee, and fulfilling their ordinary truck duties besides.

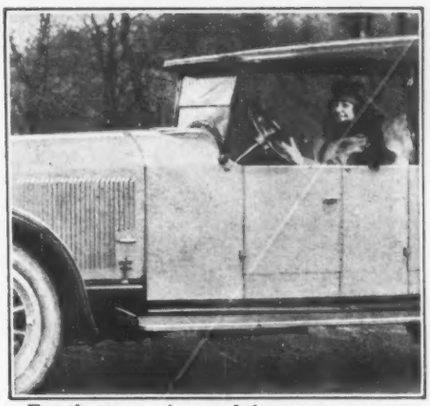
The Nashville yard is bounded by two streets and by the curving segment of a railroad main line, from which a spur track enters the yard. This track is equipped with overhead unloading chutes for the delivery of coal from gondola cars into motor-trucks. Because, as the business of the company grew, these chutes were found inadequate for more than a day-to-day supply of coal, it was determined to provide space for storage. It was found that the cost of conveyor machinery would run into thousands of dollars for equipment that would be idle about eleven months in the year.

Then some one thought of using the fleet of four trucks as conveyor machinery—and the happy solution virtually worked itself out. The storage shed was erected where it was least in the way and where the contour of the ground best adapted itself to the purpose. The shed is 90 by 190 feet in ground dimensions; its sides are open, and its roof is 25 to 30 feet "in the clear." The floor, which consists of cinders and slack coal rolled to a cementlike hardness, is on the yard level. Along one side of the shed runs an inclined roadway, climbing to the high ground immediately at the rear.

On a level with this high ground and just under the roof, three trestles extend into the shed from the rear end. The trestles, built of timbers and planking, are carried to within a few feet of the shed's forward end. Each carries, at the height of twenty feet above the floor shed, a truck track consisting of parallel plank-made channels—each about twenty inches wide and five inches deep, with the corners reenforced with angle-iron to guide and hold the wheels of the trucks.

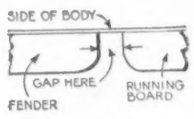
This is the method of operation: The trucks—all four of them, or as many as may be desired—are loaded with coal at the chutes on the spur track and run across the yard and up the inclined roadway to the level of the trestles. Then they are backed out on the trestles, and, by means of dumping bodies, their loads are dropped and the trucks run back to the unloading chutes to repeat the operation.

Instead of holding but fifty carloads, the 90-by-190-foot shed has a capacity of 150 carloads, and its three trestles obviate the necessity of "trimming" the piles as the storage space is being filled.



For the convenience of the woman motorist this car is equipped with a gap in the front of the running-board

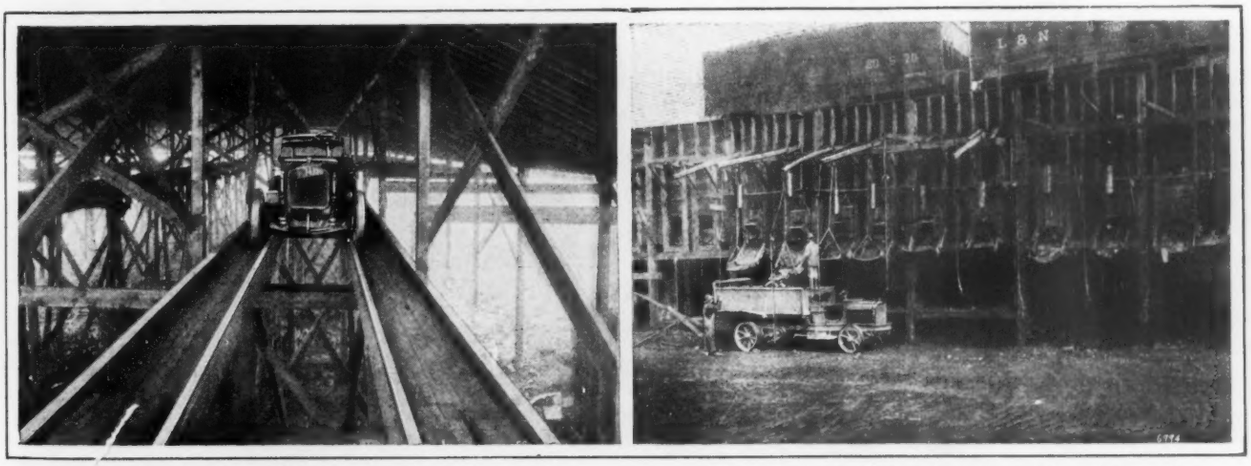
This Running-Board Makes the Engine Accessible



THE ever-increasing number of women automobile drivers is noticeable both on country roads and in city streets. Perhaps the war had something to do with it. At any rate, women handle big cars now almost as easily as do their husbands and brothers, and the average man consults his wife before he buys a car. Many of the larger car manufacturers are paying particular attention to the little conveniences that attract women.

One of the most ingenious of these conveniences is a running-board with a gap between the front end of the running-board and the bottom of the front fender. In most cars the running-board and fender are joined, but in the car shown herewith there is about ten inches of space between the two.

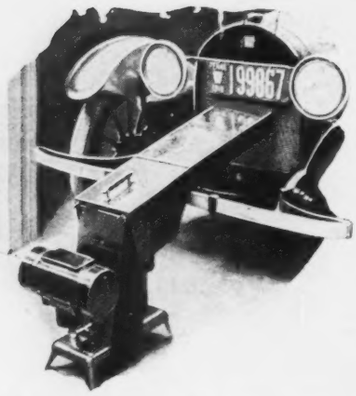
The purpose of this gap is to allow the woman driver to reach the carburetor adjustment, spark-plug wires, or electrical switches without having to lean over the fender, with the possibility of ruining her afternoon coat or gown.



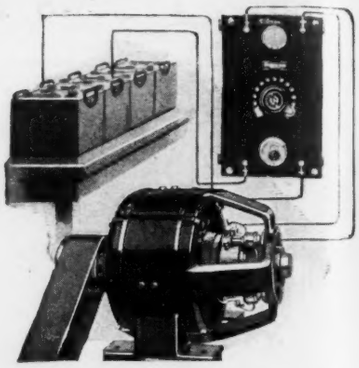
Trestles twenty feet above the ground, are built of timbers and planking, reenforced with angle-iron to guide the wheels of the trucks

The spur track that enters the coal-yard from the railroad is equipped with overhead chutes, from which the coal is dumped into the trucks

Some of the New Car Attachments for Automobilists' Ease and Safety

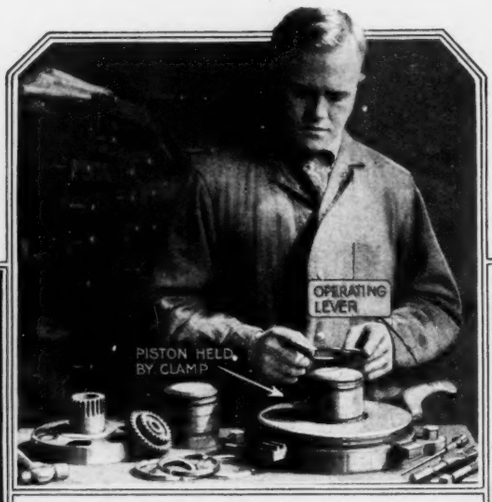


On cold days or nights, when you must leave your automobile in an unheated garage, an oil heater like that shown above will prevent damage from freezing. A hood attachment carries the heat directly to the radiator



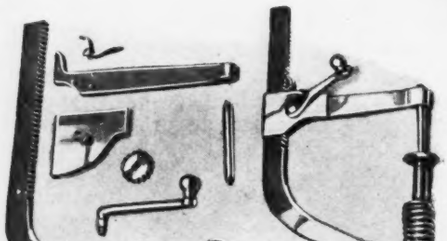
With this lighting and battery-charging set a garage can make its own electric light and have enough current available to recharge automobile storage-batteries. It operates from a line shaft or engine, requiring four hp.

Luminous figures and a luminous indicator make this gasoline gage easily read on the darkest night. This is far more convenient than matches or even a flash-lamp, as can very easily be imagined



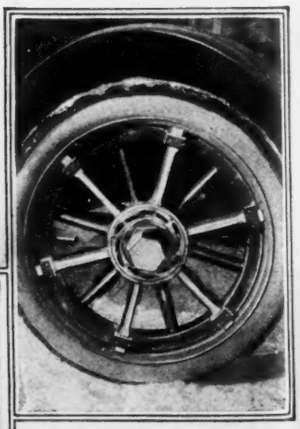
A circular vise having a range of from one quarter to four and a half inches. It holds round parts, such as hub-caps, pistons, etc., without marring them

A safety indicator, connected by cable with a front wheel of the automobile, shows a white light for city limit speed, a green light for county highway speed, and a red light when that speed is exceeded



This valve-lifter has an arm over the top of the valve and a curved arm moved by a small gear to compress the valve-spring

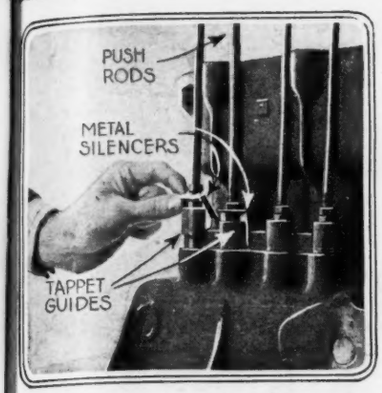
This inconspicuous lock and ball-and-socket chain hold two spare tires securely in place, preventing theft when a car is left standing



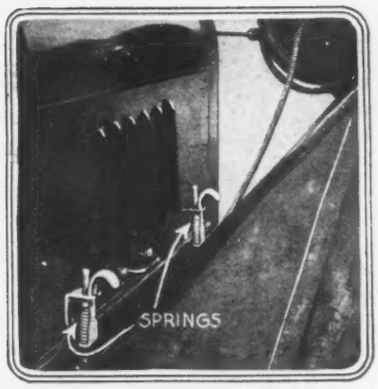
A locking device for the demountable rim, doing away with the usual nuts and lugs. It is said to true the rim perfectly

This truck is owned by a man in the scrap-iron business. A huge magnet on the end of the crane lifts the metal, facilitating loading to a remarkable degree

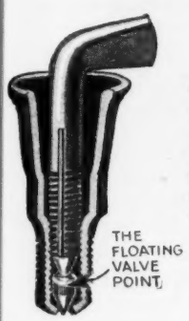
Everything from Speed Indicators to a Wheeled House on These Two Pages



Small metal pieces, placed between the nuts on push-rods and the tops of the tappet guides, will silence the annoying click of tappets in the engine of an automobile

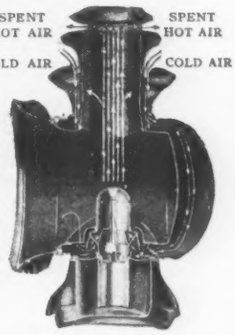


Your engine hood will not rattle any more if you will add to it the two springs here shown. It is not necessary to drill any holes in order to accommodate the springs



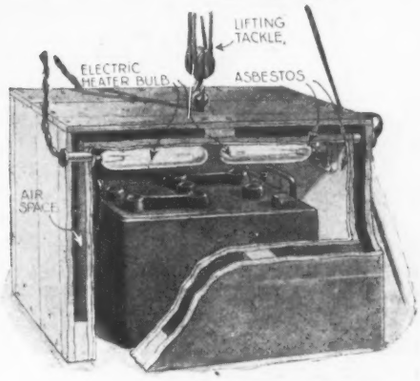
This cone-shaped floating valve-point keeps the priming-cup in place: it is not at all affected by the engine vibration

After years of experiment, chemists have at last produced an acid-proof apron. It defies the destructive effects of sulphuric acid and is cheap. It has been found very useful in automobile factories and in service stations. An important characteristic of this apron is its strength and durability

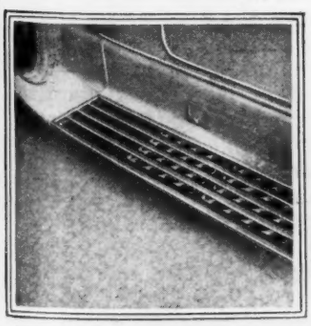


Automobile lamps stay lighted if the necessary air for oxygen is properly admitted and expelled. This double-shelled lamp has an ingenious method of doing this

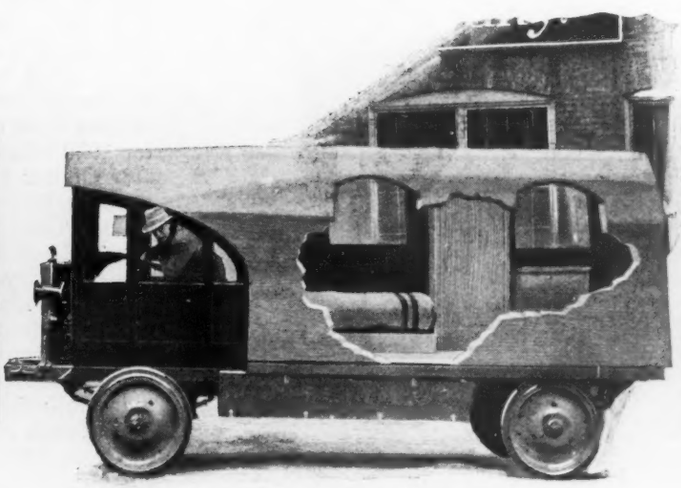
First aid for automobilists is contained in boxes like this, placed along traveled routes by the California Automobile Association, working in conjunction with the Red Cross



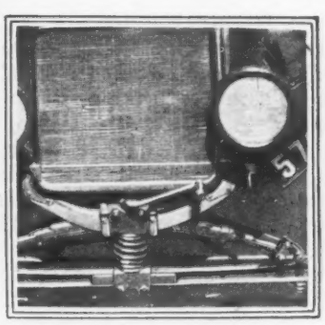
A simple and inexpensive electric oven used in a battery-charging station to soften the insulating compound. The inner box fits over one long battery or two short ones



Persons who own cars upholstered in pale gray or mauve will surely want this miniature mud-scraper, which fits on the automobile running-board



Built from a solid piece of giant redwood is this truck body. The owner, who travels and lives in it, calls it his "travel-log"



An equalizer spring that acts as a balance between the spring and the axle, eliminating shock and jar, to the benefit of both the car and its riders

A touch of a button produces gasoline from a mere drizzle to twenty-five gallons a minute

The Electrically Operated Filling Station

CRANKING has been eliminated in the newest filling station in which all the pumping is done electrically.

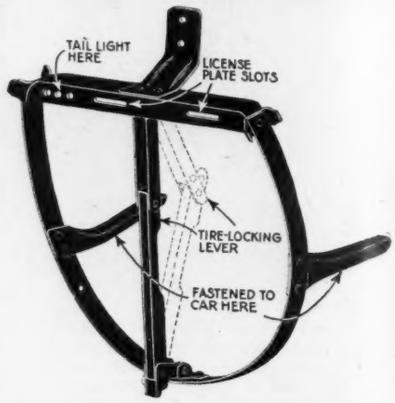
At the touch of a button it pumps gasoline at any rate you desire.

The electrical pump is connected to the storage tank in the same manner as a hand-operated pump, and may be run on any 110-volt current, either alternating or direct. The electric motor is in a case that is impervious to moisture or gas.

No Tools Needed for This Tire-Holder

IN the hand-operated type of tire-carrier shown herewith the diameter of the lower or circular part is changed when the tire is put on or taken off. This is accomplished by a two-part lever placed vertically, and hinged at the bottom to the circular part of the carrier and at the top to the horizontal portion.

When the hinge is pushed open, the circular bottom of the carrier springs up so that its diameter is decreased. Then the tire or rim may be slipped over it without difficulty. When the hinge is closed, the carrier is again sprung back.



A tire-carrier having a two-part lever, placed vertically, and hinged so the tire can be slipped on and off

Eliminating the Squeaks

Pads, made of a fabric, are used in various thicknesses to stop automobile squeaks

THERE are eleven distinct places in an automobile where squeaks are liable to occur: lamp-bracket rim; fender to frame pad in front; pad under the radiator; the forward part of the engine hood on the radiator top; the joint between the fender and running-board; the joint between the engine hood and the cowl; the windshield-rest pad; the joint between the frame and body; the joint between the rear fender and body; between the gasoline-tank straps and the metal holding it in place; and between the springs and axle-spring pads.

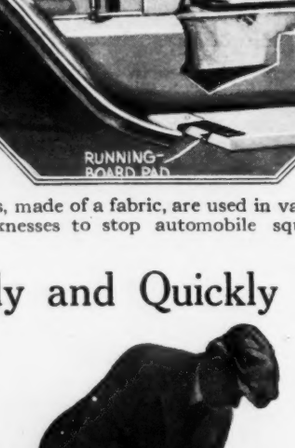
Squeaks in all of these places are now being overcome by means of a new padding made of closely woven fabric dipped in a compound of asphaltum base and allowed to dry for from two to five days. It is made, as necessary, of any thickness.

It Finds the Leak Easily and Quickly

A NOVEL spark-plug- or radiator-leak finder has been invented by the Rev. Thomas Osborn, of Centerville, Iowa, and is shown in use in the accompanying illustration. The device includes a pump, an air-tube connected with the pump, which in turn is attached to a threaded cap that screws to a long tapered tube, the large end of which is interiorly threaded and adapted to be screwed to the end of a spark-plug or to a detachable radiator cap, when the device is to be used for testing a radiator.

In carrying out the test, the spark-plug is immersed in water, and air is pumped through the device into it. If the plug is leaking, the air escaping from the plug will rise to the surface of the water in the form of bubbles.

When a radiator is to be tested, the water in the radiator will be forced in a stream through any leaking portion, in consequence of the increased air pressure from the pump.



Immerse the spark-plug in water, then pump air into it by means of this little device

The City that Has the Most Motor-Trucks

NEARLY one eighth of all the motor-trucks in use in the United States are operated by persons living in New York state, and about one ninth of all the motor-trucks in use in the Union are in New York city, the number registered for 1920 being 42,122.

No fewer than 110,000 motor-trucks were registered in New York state in 1920. This figure showed an increase over 1919 of more than twelve thousand. The industry exhibited the remarkable growth in nine years of more than one hundred thousand, the number registered for the year being 7606, which looks small when compared with the present mammoth figures.

Although motor-trucks came into use in Great Britain at least ten years before they did in this country, there are more of them in use in New York state than in the whole of the British Isles.

When Motor-Truck Trailers Pay

How to find out whether pulling is the cheapest way to haul loads

By Joseph Brinker

IN this article Mr. Brinker points out the fundamental principles that determine whether trailers pulled behind motor-trucks or tractors will reduce the unit cost of delivery. This is an involved problem, but the accompanying graphic charts, with their explanatory calculations, show how the business man can predict whether or not trailers will reduce delivery costs.

Do you want to ask questions about this or some other automobile problem? Write to the Automobile Editor of the Popular Science Monthly.

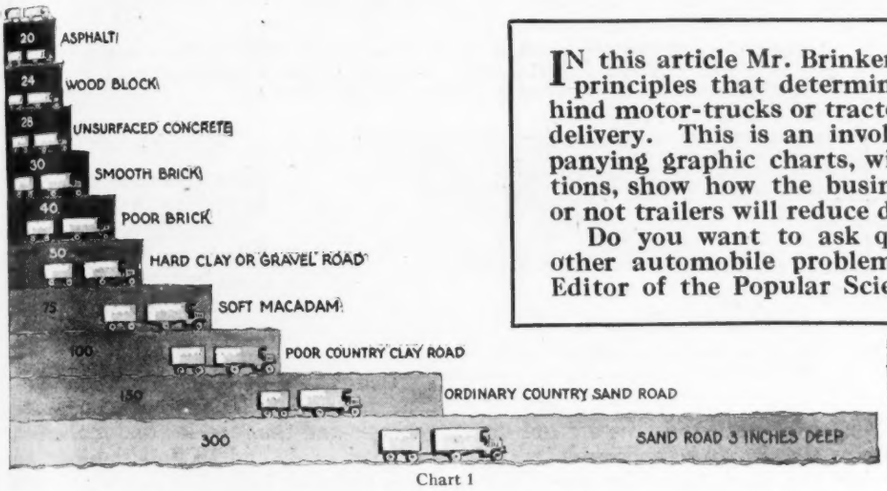


Chart 1

Showing the great difference in the pull required to move a truck and trailer over different road surfaces. The figures refer to the number of pounds' pull to the ton required to move rubber-tired vehicles over the road surfaces indicated

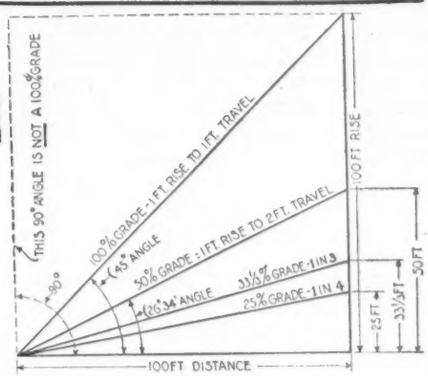

THIS 90° ANGLE IS NOT A 100% GRADE
90°
100% GRADE - 1 FT RISE TO 1 FT. TRAVEL
45° ANGLE
50% GRADE - 1 FT RISE TO 2 FT. TRAVEL
26°34' ANGLE
33⅓% GRADE - 1 IN 3
25% GRADE - 1 IN 4
100 FT RISE
50 FT
33⅓ FT
25 FT
100 FT DISTANCE

Chart 2

The relation of the angle of grade and percentage of grade, terms that are often confused. Grade is measured by ratio of vertical rise in feet to horizontal distance traversed in feet. A 100-foot rise in 100 feet horizontal distance is a 100-per-cent grade

CENTURIES ago man discovered that it is easier to pull than to push. This is the fundamental principle that underlies the motor-truck trailer of today.

The motor-truck, like any draft animal, can pull more than it can carry; and the trailer is the means whereby the truck can be utilized to pull more than it can carry.

Three kinds of trailers are in use today. There is the four-wheeled trailer, a complete vehicle in itself, carrying its own load, either with or without an additional load on the pulling truck or tractor. There is the semi-trailer, a two-wheeled vehicle that carries part of the load, with the rest supported by the pulling vehicle; the two-wheeled trailer, in which the load is balanced over the trailer axle, the pulling vehicle simply serving to pull the trailer.

These, then, are the three types of trailers from which the business man must choose when he desires to make his trucks pull more than they can carry. It does not follow that the cost of delivery with a five-ton truck is cut in half if the same truck pulls behind it a five-ton trailer and moves ten instead of five tons a trip.

There are, however, some fundamental uses where trailers are more than likely to prove profitable to the truck-owner. The most general of these is the haulage of loads of such bulk that they cannot be placed in the largest truck body. With loads of greater weight than the largest truck can carry, especially built trailers, of course, must be adopted. Haulage of boilers, heavy pieces of machinery, monolith stones, etc., are good examples of bulky and heavy loads for which the trailer is a necessity.

With the bulky yet light load the problem is very different. The small unit weight of the load makes it impossible to carry in the average truck body a load anywhere near the total weight-carrying capacity of the truck. Of course, the size of the body may be increased; but body size has its limits. When the body has been increased to its size limit and the weight of the load that can then be carried is still below the full carrying capacity of the truck, the trailer will probably save money.

Where a Trailer Saves Money

Wherever the time of loading or unloading a truck is excessive because of numerous small pieces that must be loaded one at a time, the trailer has a good opportunity of cutting costs by increasing the actual running time of the truck in comparison with its standing time while being loaded or unloaded.

As has been pointed out in previous articles in this series, the most important factor in highway transportation is to keep the truck moving. While running, the truck is making or saving money. While standing still, it might just as well be a warehouse. If one or more trailers, loaded while the hauling tractor or truck is out delivering one load, will enable the tractor or truck to cover more ground or make more trips in a day, those trailers may appreciably cut the delivery costs.

Wholesale grocers, as a class, have been quick to take advantage of

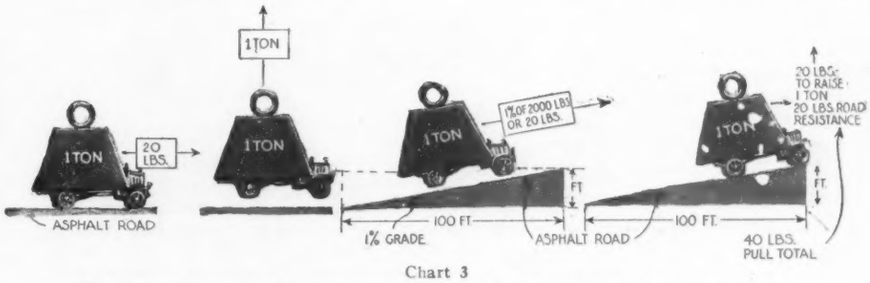


Chart 3

This shows how road resistance must be added to grade resistance to determine the total pull required to move a loaded truck or truck and trailer up any kind of a hill

trailer use. A five-ton load of groceries may consist of several hundred small packages or boxes, each of which must be loaded separately by hand. This takes from one and one half to two hours. Yet if this same load is put on a trailer that is held waiting for the truck or tractor when it reports in the morning or when it comes back from another trip, the loading time, as far as the truck or tractor is concerned, is cut to the five or ten minutes required to couple the loaded trailer to the pulling vehicle.

Keep the Tractor Running

If the pulling vehicle is a tractor or road locomotive, carrying no load of its own, it can be kept running almost continuously, except for the time spent in discharging small portions of the load at each store. The five- or ten-minute loading time consists in merely disconnecting the empty trailer and coupling up the loaded one.

In the cases cited, where extremely heavy integral loads and bulky yet light loads have to be carried, or where loading and unloading time may be reduced, the work of the trailer is fairly well known and fairly well understood. The correct use of the trailer is not so well understood in the haulage of ordinary bulk or piece goods, where there is no trouble in carrying a full-capacity load in the average truck body, and where loading and unloading times have been cut to the minimum by mechanical loaders and self-unloading or dumping bodies. Here the problem is one, not of expediency, but of possible reduced costs. The truck-owner may then ask: "If my truck will pull more than it can carry, why not make it a pulling instead of a carrying vehicle, and, by carrying more goods to a trip, cut the cost of each ton or package moved?"

Upon the proper answer to this question depends the future development of trailer transportation. To understand the question, one must go back to the very beginning. In the case of the motor-truck, the truck is provided with an engine that is capable of performing a fixed amount of work, depending, of course, upon the design of the truck, its weight, the amount of power consumed in friction of the moving parts, and the condition or state of wear of all moving parts. The important thing to remember is that the amount of work that any given truck can do is fixed. It cannot be increased beyond definite limits.

Work may also be expressed as the overcoming of resistance through a certain distance. Power is the rate of doing work, and may be expressed by dividing the work done by the time in which it is done. In the case of the motor-truck, the work of the truck engine is expended in overcoming the resistance between the wheels of the truck and the road over which it is running, this resistance increasing directly with the weight of the truck.

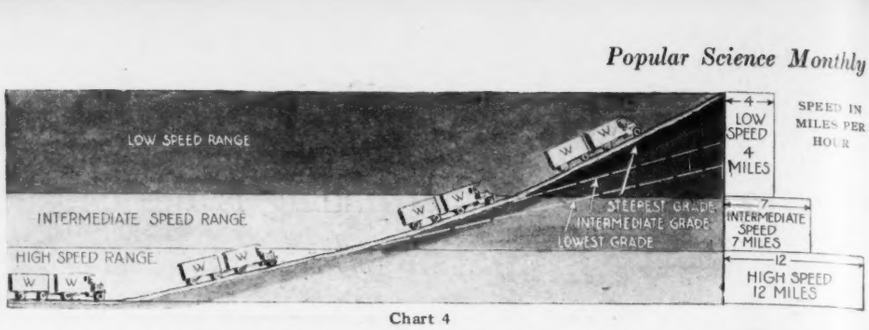


Chart 4

A chart showing how the speed of the truck and trailer becomes lower as the grade increases. The reduction in speed of a truck and trailer on hills may more than offset the advantage gained in hauling increased loads

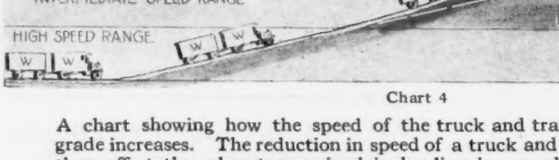


Chart 5

Truck W ascending the same grade as indicated in the chart above, but at the intermediate truck speed of seven miles instead of the low truck speed of four miles an hour

How About the Uphill Pull?

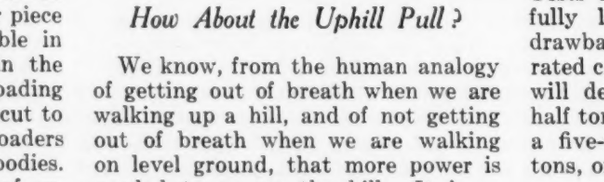
We know, from the human analogy of getting out of breath when we are walking up a hill, and of not getting out of breath when we are walking on level ground, that more power is needed to go up the hill. It is so with the motor-truck. For, while the work ability of its engine is fixed, the power must be changed by a reduction in speed. This is equivalent to an increase in time, and is secured in the case of a motor-truck by increasing the leverage of the engine upon the driving wheels. This, in turn, is secured through the medium of the change-speed gears, which are nothing more than levers in circular form. The larger the lever or gear, the slower the speed of the truck in ascending the hill.

Virtually all trucks are fitted with engines of sufficient work ability and with gear changes to provide enough power to carry full loads over poor roads where the resistance between truck wheels and the road is greater than on a good road, and to pull the load up any ordinary hill. Because trucks are thus built to move their loads under the worst conditions of roads and grades, they have a surplus of power when operating under the best conditions. It is this surplus of power or drawbar pull that is utilized when the truck is employed to pull a trailer. Tests have proved that the average fully loaded truck will develop a drawbar pull equal to one half of its rated capacity. Thus a one-ton truck will develop a drawbar pull of one half ton, or one thousand pounds, and a five-ton truck, two and one half tons, or five thousand pounds.

Roads Must Be Studied

The ability of a truck and trailer or a truck alone to move under full load over any kind of road surface and up any kind of hill depends upon whether its tractive force or drawbar pull is greater than the resistance of the road and the grade. A motor-truck requires more power to travel over a clay road than over a concrete highway. The road resistance is least for asphalt and greatest for a loose sand road. Chart 1 gives the road resistances in pounds to the ton for rubber-tired trucks and trailers on different types of roads.

The additional resistance of grades may be also expressed in pounds to a ton, according to the steepness of the grade. Grades are generally measured in percentage, that is, a grade of five or ten per cent shows the relation between the angle of a hill and its percentage of grade, two terms that are often confused, but that must be perfectly clear in



Here is shown a road train containing three types of trailers. The two-wheeled semi-trailer has its front end mounted directly upon the tractor; next comes the two-wheeled trailer balancing its own load, and, at the end, a four-wheeled trailer. The figures indicate the distribution of weight

order to determine whether a given truck will pull a trailer up a given hill. A hundred-per-cent grade is a hill in which the vertical rise is one foot for every foot in the horizontal length of the hill. A grade of one hundred per cent is a hill with an angle of forty-five degrees, *not* ninety degrees.

Road resistance to a vehicle moving uphill is equal to the road resistance on the level plus a resistance due to the grade of the hill. While the road resistance for any kind of road remains constant for that kind of road, the additional resistance that must be added for the grade increases directly as the grade increases. This is shown graphically on page 79. From Chart 1 it will be seen that a tractive force of twenty pounds to the ton is required to overcome the road resistance of twenty pounds a ton on a level asphalt road. If the same ton had to be lifted vertically, it would require a force of one ton or two thousand pounds. On an asphalt road with a grade of one per cent, it would require a force of one per cent of two thousand pounds, or twenty pounds. The total tractive force thus required to overcome the road and grade resistance would be forty pounds a ton. For a grade of two per cent, the road-surface resistance would remain at twenty pounds, but the grade resistance would increase to forty pounds, or a total road plus grade resistance of sixty pounds a ton.

Road Surface, Grades, and Speeds

Because greater tractive force is required to balance the grade resistance as the percentage of grade of a hill increases, most trucks must make use of their change-speed gears when ascending a steep hill. The steeper the hill, the lower is the gear that must be used and the lower is the truck speed.

It is thus seen that road surface, grades, and speed are the three important factors upon which the success of trailer transportation depends. This is shown graphically in Charts 4 and 5. Chart 4 shows how a fully loaded truck can ascend a hill to a certain point in high speed at the rate of twelve miles an hour. Above that point it must drop into second or intermediate speed, which makes the truck travel at a rate of seven miles an hour. What happens when the truck attempts to pull a loaded trailer up the same hill is shown in Chart 5. It is seen that the truck must drop into low speed to reach the top of the hill, and this reduces the speed of the truck-and-trailer combination to four miles an hour—three miles an hour less than if no trailer were hauled.

Trailers Not Always Economical

It is thus conceivable that any increased efficiency that is gained by delivering a trailer load in addition to that on the truck might be more than offset by the reduction in the speed of the truck-and-trailer combination, as compared with the truck alone. In other words, in hilly country and on poor roads, two trucks working alone might be able to deliver goods more cheaply than one truck and one trailer, even if the cost of operation of the two trucks were greater than that of the truck and trailer.

While ideal conditions for trailer use are those of level roads and good pavements with low road resistances, Chart 6 shows how to determine whether a given truck can haul a trailer under given conditions, and at what speed the truck alone and the truck and trailer can be operated under those conditions. It is assumed that the five-ton truck weighs four and one half tons, or nine and one half tons, including a full load, and that a five-ton trailer weighs two tons, giving a total trailer weight with a load of seven tons. This gives a final truck-and-trailer weight of sixteen and one half tons. The resistances for each of the six different conditions of surface and grade shown in Chart 6 are figured separately for the truck alone and for the truck and trailer, the unit road resistances being taken from Chart 1. Thus the total resistance that must be overcome by the truck and trailer in road condition No. 1, a hard clay road with a ten-per-cent grade, is shown to be 4125 pounds, which is just below the maximum tractive force of the truck in low speed, 4160 pounds. The maximum tractive force of 4160 pounds is figured from the formula

$$\text{Tractive force} = \frac{T \times R \times 12}{W}$$

where $T = 0.55 \times D$

and

R = Total gear ratio

T = Ft.-lbs. of torque

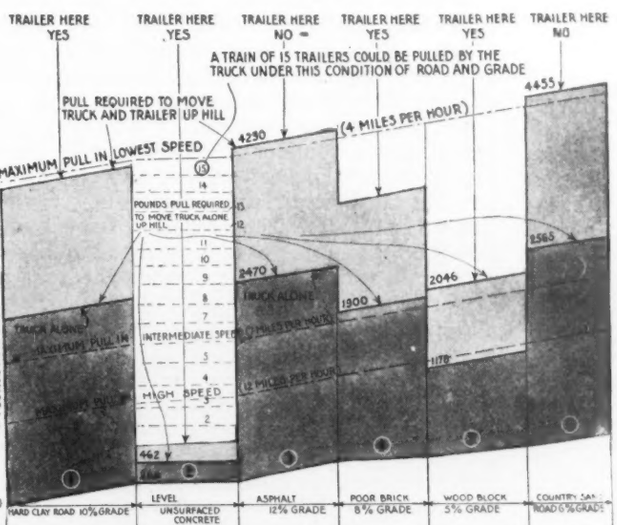
W = Driving-wheel diameter in inches

D = Piston displacement in cubic inches.

Will It Pay?

A further study of Chart 6 shows that the truck could pull the trailer under road conditions Nos. 1, 2, 4, and 5, but could not pull the trailer under road conditions Nos. 3 and 6. Under condition No. 2, both the truck alone and the truck and trailer together could travel in high speed corresponding to twelve miles an hour. Under condition No. 5, the truck alone could travel in high speed, but with the trailer would have to drop into intermediate speed of seven miles an hour. In the other three conditions under which the trailer could be pulled, the outfit would have to travel in low speed corresponding to four miles an hour.

After determining whether a trailer can be hauled as shown in Chart 6, the next step is to determine the time of the haul with the trailer by using the speed shown and taking the length of each kind of road. This will determine how many trips can be made in a day and the tonnage that can be carried. Under ordinary conditions the cost of the truck-and-trailer operation will be about twenty-five per cent in excess of the cost of the truck operation alone. Dividing the cost of the truck-and-trailer operation by the number of tons moved, will give the average cost to a ton. If this is less than the cost for each ton with the truck alone, the use of the trailer will pay.



		HARD CLAY ROAD 10% GRADE	LEVEL UNSURFACED CONCRETE	ASPHALT 12% GRADE	POOR BRICK 8% GRADE	WOOD BLOCK 5% GRADE	COUNTRY SAN ROAD 6% GRADE
TRUCK AND TRAILER	Road Resistance	16.5 X 50 = 825	16.5 X 28 = 462	16.5 X 20 = 330	16.5 X 40 = 660	16.5 x 24 = 396	16.5 x 150 = 2475
	Grade Resistance	16.5 X 20 X 10 = 3300	16.5 X 0 = 0	16.5 X 20 X 12 = 3960	16.5 X 20 X 8 = 2640	16.5 x 20 x 5 = 1650	16.5 x 20 x 6 = 1980
	Total Resistance	4125	462	4290	3300	2046	4455
TRUCK ALONE	Road Resistance	9.5 X 50 = 475	9.5 X 28 = 266	9.5 X 20 = 190	9.5 X 40 = 380	9.5 x 24 = 228	9.5 x 150 = 1425
	Grade Resistance	9.5 x 20 x 10 = 1900	9.5 X 20 X 0 = 0	9.5 X 20 X 12 = 2280	9.5 x 20 x 8 = 1520	9.5 x 20 x 5 = 950	9.5 x 20 x 6 = 1140
	Total Resistance	2375	266	2470	1900	1178	2565

Chart 6

How to determine if a given truck can haul a given loaded trailer under the six assumed conditions of road surfaces and grades. The boxes of figures indicate how the total road resistance for surface and grade is calculated for each condition

How to Refinish Your Automobile

Concluded from the February number

BE sure that the brush is clean. Thoroughly wash it in benzine or turpentine to rid it of any possible dust or grit. During this operation the automobile should be housed in a room as nearly draft and dust proof and as clean as possible.

This first coat is the metal primer mentioned above and is procured in form ready for use. The red lead may be thinned with oil and applied to any spots particularly hard to free from rust.

After this coat has been applied, it should stand for 12 hours to dry thoroughly; 24 hours would be better. If the workman doing the job can arrange to do the work in the evening for 2 hours and thus let 24 hours elapse between each step, he will be assured of a good job.

The second coat is the priming coat proper. The best quality of white lead should be used, thinned down with pure linseed oil. This gives a pure white color, and lampblack may be added to tone it down. To this mixture are then added 25 parts of oil, 25 parts of gold size or coach japan and 50 parts of turpentine. This mixture should be thoroughly agitated to produce an even mixture.

In applying this coat, care should be taken not to apply the mixture on too large an area at one time. A space 2 ft. or so square will be sufficient, and this portion should be thoroughly covered before starting the next. While this second coat will require only 12 or 15 hours for drying, 24 hours will not do any harm.

Make a Putty Filling

If any depressions or small crevices show after these two operations, a putty should be prepared to bring them up level with the rest of the surface. The putty is made by thoroughly mixing white lead with fine bolted whiting. This thick dough is kneaded and worked until it is in a plastic form and thoroughly homogeneous. Small portions of it may then be pressed into the depressions with a putty-knife.

It is essential to have the surface built up into an extremely smooth area, entirely free from dust particles and anything which would tend to mar the finished surface. A dust particle left on at this stage will be ten times as large by the time the last coat is on. The surface should be gone over with the fine sandpaper or emery-cloth and all rough places should be smoothed down. Care should be taken that the pressure on the abrasive is light and uniform, and under no circumstances cut through either of the coats already applied.

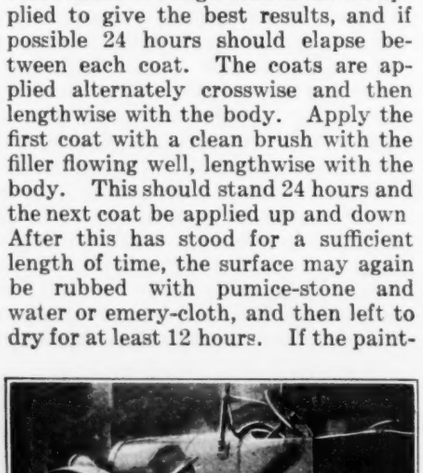
It now becomes necessary to thoroughly wash the automobile. The sandpaper which was used leaves particles here and there and the dust must be removed.

Plenty of water and a sponge will be needed. Sponge the surface from the top down, washing all particles to the lower edge. Two rinse-waters should also be dashed on. A chamois-skin is then used to dry the surface. As a final precaution, place two or three drops of linseed oil on the hands, rub them together and pass the tip of a brush over them. With this go lightly over the surface once more,

How to rub down the surface with fine sandpaper is illustrated on the right; on the left the careful washing with a sponge and plenty of water

and give the moldings and corners special attention. Any remaining particles will be picked up by the oil on the brush.

Now we come to what is known as rough-stuff filler. This filler may be purchased in cans ready for applying, after shaking thoroughly. It is applied to fill in any remaining inequalities on the surface of the car. Two or three coats of rough-stuff must be applied to give the best results, and if possible 24 hours should elapse between each coat. The coats are applied alternately crosswise and then lengthwise with the body. Apply the first coat with a clean brush with the filler flowing well, lengthwise with the body. This should stand 24 hours and the next coat be applied up and down After this has stood for a sufficient length of time, the surface may again be rubbed with pumice-stone and water or emery-cloth, and then left to dry for at least 12 hours. If the painting is being done in the garage and this garage is furnished with artificial heat, it will be expedient to see that the interior of the room remains at a temperature of 85 or 90°. This is not necessary, but it will hasten the job.



Putting a coat of quick-drying varnish over all painted surfaces is the final operation. It should be done with care

Care should be taken in rubbing moldings and curved surfaces. The best way to rub down moldings is to prepare a small wood block with a groove in one side matching the contour of the molding and then line it with fine emery. A still better way will be to use pumice-stone hollowed out to fit the molding. A great deal of time may be spent in finishing the automobile at this stage. The surfaces are given another washing and dried off with the chamois-skin.

It is now time to select the color of the paint to be used. Two or three coats of this color paint will be required, though sometimes only one coat of the color is used when it is covered with a color varnish.

Applying the Color

At this juncture a japan coat of color is applied. This dries exceedingly hard and is by far the best finish for an automobile. This also comes ready for use, and details regarding it need not be put down here. This surface, after having been applied, should dry for at least 2 days. Rub down the surface and wash. When thoroughly dry, apply a second coat. Three or 4 days should elapse between the first and second coats. It will be remembered that there are a number of coats of different kinds of materials on the metal surface and that they have not yet become thoroughly affixed.

The next and last coat is simply a varnish coat applied to maintain a keen and lasting luster to the color coats. This varnish is of quick-drying properties and should be applied with care. Starting with the hood or a door panel, cover the surface thoroughly, catching up any surplus that starts to run. Smooth out all bristle traces and proceed to the next piece. When varnishing the back of the automobile, the strokes should be made up and down and from right to left or left to right. After once leaving a portion, it should not be touched again.

As this process is being completed keep on the lookout at all times for particles of dust, bristles, and any other foreign matter which will mar the surface. These must be detected and removed at once, for if the varnish dries over them, the blemish will be permanent.

When this final coat has thoroughly dried, go over the surface once more with a wet sponge. All that remains now is to give the surface a good polish. A soft chamois-skin deftly han-

dled will bring out a luster which will rival that of a new automobile.

The fenders may be finished in the same way, but it is not necessary. By omitting several of the rubbing-down and filling-in processes the result will be good and save considerable time.

Briefly, the bearings, springs, and axles are to be given two or three coats of the desired color, without other precaution than to see that each coat is dry and free from dust before the succeeding coats are applied.

If the wheels are of wood and the spokes in natural color, clean them with the varnish remover, if they are in bad condition, and apply two or three coats of varnish. If the spokes are in good condition, smooth them down and apply only one coat of the varnish.

The steps just narrated include all operations necessary when the old paint has been removed. If, however, the automobile finish is comparatively free from cracks as above described, all of the steps, including paint-removing, rough-stuff fillers, and color coats, may be omitted. The last three operations only will be required. Perhaps one coat of color should be applied, however, together with the varnish coats. If the color is to be changed, start in with the first color coat.

In monogramming or providing the automobile with initials, the letters are applied after the last coat of color.

The task of refinishing a used automobile is not as complex as it looks. Completely finish one step before undertaking the next. Follow the simple sugges ions just put down, and you will be ahead some forty or fifty dollars.

To make the job complete, the engine and working parts should be gone over. Various hints and tips are given along this line in these pages from time to time and need not be detailed here.

While you are at it, it will be well to give the top a coat of waterproofing material. Also, go over the nickel and exposed metal parts wherever possible with a rag dampened with oil and attend to any minor repairs necessary to the upholstery and interior.

To Keep the Boys at Home

THE game illustrated here can be made at home as a plaything for young and old. The board is made of several widths of ¾-in. stock joined together and then cut with a coping-saw to the proper form. Strips of tin,

Provide an entertaining pastime like this game and your boys will enjoy remaining at home

2 in. in width, are then nailed around the sides to prevent the balls with which the game is played from jumping off.

Pieces of rubber, cut to the proper shape, are cemented on the corners and sides facing the playing end of the board. Pockets are cut into the wood to a depth of ½ in., as shown in the illustration. The top of the board is covered with green cloth, which is glued to the board and also covers the rubber and tin sides.

The holes are marked around the edge with rings of bright color and are numbered. The game can be played with one white and one or more red balls.

The white ball is placed on the spot somewhat to one side of the center line, as shown in the illustration. The red ball is placed on the spot in the center. The player cues the white ball, makes it strike the red ball, so as to drive the red ball through the aisle along the center line of the board. The object is to cause the red ball to drop in one of the pockets provided in the different parts of the board.

The ball which drops in one of the two holes in the section remotest from the playing end counts 100 points; the holes in the next compartment count 50 points each, those in the third 25 each, and those nearest to the playing end 10 points each. Whoever makes the largest number of points, wins the game. Whoever misses the red ball, scores a scratch. The punitive value of this scratch may be fixed according to the desire of the players by agreement.—JOHN MARTIN LANG.

Fastening Screws in Stone or Concrete Walls

HOUSEKEEPERS who live in houses with concrete, brick, or stone walls usually find it very difficult to hang pictures or brackets in their rooms even when they have succeeded in drilling or chiseling a hole in the concrete or brick. Neither nails nor screws will hold in these holes, which necessarily must be made quite large.

Electricians who are called upon to attach electric-light fixtures to such walls, usually drill holes, fill them with lead and fasten the screws in the lead. Sometimes they use what is called expansion sleeves, which are so designed that the screw, as it is screwed into the sleeve, causes the part of the sleeve farthest away from the surface to expand, thus taking firm hold of the surrounding concrete or brick.

All housekeepers who are not expert electrical workers should try steel wool, such as is used for scouring metal surfaces. This furnishes an excellent substitute for lead filling or expansion sleeves. The hole should be drilled to the depth of at least 1 in. and wide enough to hold a sufficiently large screw. Then place a wad of steel wool in the hole and drive your screw through the wool into the hole. You will find it impossible to pull a screw fastened in this manner out of the hole with your hands.—E. J. HOLMES.

Remove a Tight Ring with Rubber Bands

A GREAT deal of mischief often results from a ring that is too tight on a finger, the flesh as a rule swelling up around it. This generally leads to attempts at filing it off, which sometimes results in accident.

A ring can be removed without the necessity of filing if the following directions are pursued: Wrap a flat rubber binder of ⅛-in. width on the finger above the ring, beginning at the tip and working down. Lay it closely but not too tight. When the ring edge is reached, hold the hand up in the air for a few minutes. It will then be noticed that the swelling is going down.

Now release the rubber and wrap the finger down to the ring again. Keep on the rubber for about five min-

Begin winding at the tip and gradually force the blood out of the finger

utes and then release it. This time the swelling should be taken out and it is possible to slip the ring off. Do not, however, wait long after the binder is taken off before getting the ring started or the swelling will again take place.

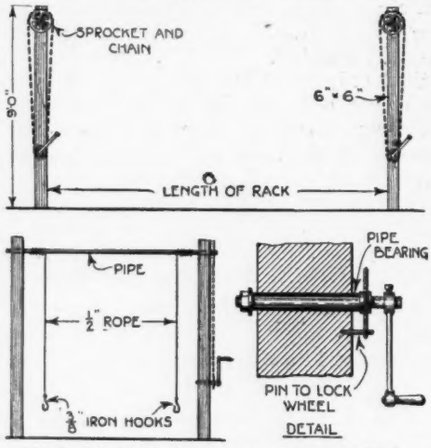
If the finger is rubbed with sweet oil or lard in the interval when the rubber is released, it will aid materially in the removal of the ring.—ROBERT PAGE LINCOLN.

How to Build a Hoist for the Hayrack

ONE of the few things that are done still in the old way about the average farm is unloading heavy hayracks by hand. As often as the wagon gear is changed from the wagon box to the hayrack and back again, backaches and strained muscles are in evidence, for the shifting of a hayrack of modern dimensions is no one-man task. After being laid up in bed for a week with lumbago, which was brought on by putting on a hayrack single handed, a farmer erected a hayrack hoist after the manner of the one shown in the illustration. No matter how many times the rack has to come off and go on again, it is a simple task to do the work.

Necessary parts were procured from an old-time binder that had long since sought the scrap-heap. Four 6 by 6 in. posts were set into the ground a distance of 4 ft., each spaced similarly to the corners of the rack. The length of the hoist is the length of the rack, while its width is the width of the rack plus 1 ft. These posts were cut long enough to enable the rack to be driven under without interference for unloading. Two gas-pipes 1½ in. in diameter were cut 6 in. longer than the outside distance of the ends of the hoist, with holes bored a few inches from the tops of the posts to accommodate them. Small holes were drilled in each end of the pipes, so that when in place, bolts could be put through on each side of the post to keep them from working out.

Two sprocket wheels, each of the same size, taken from the binder when keyed to the pipes as shown, completed the top of the hoist. The manner in which the cranks and lower sprockets were arranged is shown in the detail. Holes were bored through the posts at a convenient height, and 7-in. lengths of gas-pipe were driven in to a wedge fit. The handles were bent from a rod just large enough to fit the pipe bearings nicely and were threaded on the inside end as shown.



With this hoist, the construction of which is shown in detail, two men, or even one, can lift a heavy hayrack off the truck

The smaller sprocket wheels, when keyed to these shafts, and the nuts put on to keep the handles from working out, finished the hoist. An ample supply of chain to fit the two mechanisms was found on the binder.

To use this hoist, 4 lengths of ½-in. rope were required. One end of each was run through a hole drilled through the pipe for the purpose, and hooks were tied to the lower ends so that they were of the same height.

In unloading the rack, the wagon is driven between the side posts, and the cranks turned until the hooks are on a level with the cross-bed piece of the rack at the front and back. The hooks are then slipped under these pieces, and the cranks operated one at a time, if need be, until the rack has been raised clear of the running gear of the wagon. If this is done alone, it will be necessary to turn one crank and then the other alternately, in order not to cause any binding between the standards.

How was the rack kept raised? A hole was bored into each crank-post between spokes of the smaller sprocket wheel, and an iron pin slipped in after the rack had been raised.

It will be noticed that this device prevents any swaying by the wind, as all four corners of the rack are supported, and if the rack is raised so that the top is above the gas-pipes, there will be no play forward and backward.—DALE R. VAN HORN.

Change Your Tires in Comfort

WHAT automobile owner has not indulged in, or at least witnessed, the backaching effort required in removing or replacing a tire as the wheel wanders here and there across the garage floor, to the serious detriment of enamel and temper? Even to change a tire with the wheel on the automobile is not a joyful occupation.

You need not fear backache or sore muscles if you change or repair tires with this homemade wheel-holder

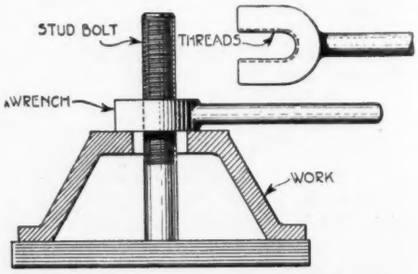
Here is a simple method by which tire-changing is rendered less strenuous. To the center of a stout wooden frame a dummy hub is bolted and the frame hung on the garage wall at a convenient level. The wheel, with its tire on, is screwed on to the dummy hub and the operator takes his seat on a chair, with tire levers, etc., ready to hand. The tire may then be removed with ease and a new one substituted, without rising from the chair at all and without any strain. Incidentally the chalking of the new cover is effected in a most satisfactory manner, as all loose chalk works down to the lowest level.—P. J. RISDON.

A Practical Use for Old Phonograph Needles

DISCARDED phonograph needles are usually considered worthless and are thrown away. These needles may be used for different purposes. Draftsmen and engineers will find that discarded needles for almost any type of phonograph will serve to replace the points in compasses and similar drafting instruments without requiring any special adaptation.—E. NYE.

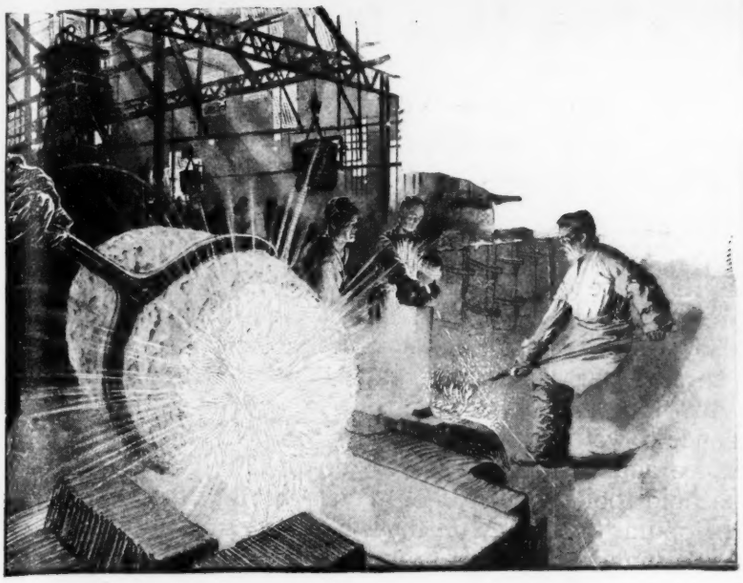
Making a Clamping-Wrench for the Shop

IN shop work it often becomes necessary to fasten a piece of work around a long arbor in such a manner that it may be removed or its position changed quickly. Then a clamping-wrench as illustrated will be found extremely useful. The wrench-nut will slip into the threads of the clamping-stud anywhere within one quarter of a turn from tight, and upon loosening will come off easily.



A clamping-wrench that will slip into the threads of the stud at any point and can be tightened or released by a quarter-turn

To make a wrench-nut, suspend a tap on centers in the lathe, clamp the nut to compound rest, set the lead, and use the tap as a hob.—R. F. POHLE.



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Finding New Uses for Old Things

What use have you for some of the "junk" in the attic or cellar? Popular Science Monthly will pay ninety dollars for the best answers

THERE is the old baby-carriage, the old stove, the old bureau, the trunk, and the leaky wash-boiler. The attic also contains old phonograph needles, safety-razor blades, carpets, curtains, chairs, tables, picture-frames, hat-boxes, etc. Have you been able to save money and add a convenience to your home by pressing some of these things into service again? If you have, you probably had to get the household tool-kit out to help you. Sit right down now and tell Popular Science Monthly what changes you made and how you made them. It makes no difference what you changed, as long as it was old. You may win one of the prizes.

The Popular Science Monthly offers three prizes for the best answers—a first prize of $50, a second of $25.00, and a third of $15.00. These will be awarded in accordance with the rules outlined below.

Rules Governing the Contest

(1) Contestants are not limited to the number of ideas, but only one method can possibly win the first prize, only one the second, and only one the third. The contest is open to everybody.

(2) The use of the old piece of junk must be shown clearly, either in a photograph or in a drawing. If a drawing is sent in, it need not be made by a skilled draftsman. It is sufficient that it should be intelligible. While pencil sketches will be considered, contestants are requested to make their drawings in ink on heavy white paper. The views should be sufficient in number to set forth the writer's idea very clearly. The contestant's name and address should appear on each sheet of drawings.

(3) The drawings or photographs must be accompanied by a description, preferably typewritten, in which the method is clearly given. It must be written on one side of the paper only, and it should not be more than 500 words in length. The name and address of the contestant should appear in the upper left-hand corner of the first sheet of the written description.

(4) The drawings and description entered by contestants must be received by the Popular Science Monthly not later than 5 p. m., on June 15, 1921.

(5) The judges of the contest will be the editors of the Popular Science Monthly.

(6) The first prize of $50 will be awarded to the contestant who, in the opinion of the judges, has suggested the best use for an old piece of junk.

The second prize of $25 will be paid to the contestant who submits an idea next in merit.

The third prize of $15 will be paid to the contestant who submits an idea third in merit.

(7) The winners of the contest will be announced in the earliest possible issue of the Popular Science Monthly. A description of the ideas which win the three prizes offered will duly appear in the pages of the Popular Science Monthly, together with the names of the winners.

(8) The editors of the Popular Science Monthly shall have the right to publish meritorious manuscripts that do not win a prize. The regular space rates will be paid to the contestants who submit the manuscripts thus selected.

(9) When a contestant submits more than one idea, the description and drawing by which each is set forth must be sent as a separate unit.

(10) Manuscripts or drawings will be returned to contestants if stamps are enclosed.

(11) Send drawings and specifications to the Editor of the New Uses for Old Things Contest, Popular Science Monthly, 225 West 39th Street, New York City.

The Poultry-House Door Opened by the Roost

THOSE persons who dread to get up early to let the hens outdoors after cold weather sets in will appreciate an automatic door-opener operated by the fowls themselves.

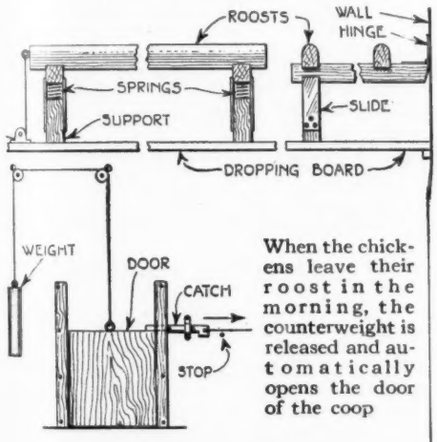
The operation depends upon the movement of the roost when the fowls jump down from it in the morning. The device is extremely simple and quite inexpensive to install.

Of course the owner has to close the door at night and set it for opening in the morning.

The roosts are bolted to two roost supports that are hinged to the back wall of the poultry-house in the usual position over the dropping-board. These two supports set down in metal slides arranged on short posts directly below the ends of the supports. When the roosts are empty they are held up from the posts by two spiral springs, one at each end.

A cord is attached to the end of the front roost and led through a pulley on the dropping-board to the door-catch.

The door is arranged to slide up and uncover the opening in the side of the house. Slides are provided as guides



When the chickens leave their roost in the morning, the counterweight is released and automatically opens the door of the coop

at each side. It is lifted by a counterweight as shown in the detail sketch.

The catch is a piece of stiff metal with a lug and a small hole at one end. The long portion slides in a slot in one of the door guides so as to clear the top of the door when it is closed. A second metal slide is provided on the wall so the catch will slide true. A screw acts as a stop for the lug to prevent the catch's pulling out. The cord from the roost is attached to the hole in the catch.

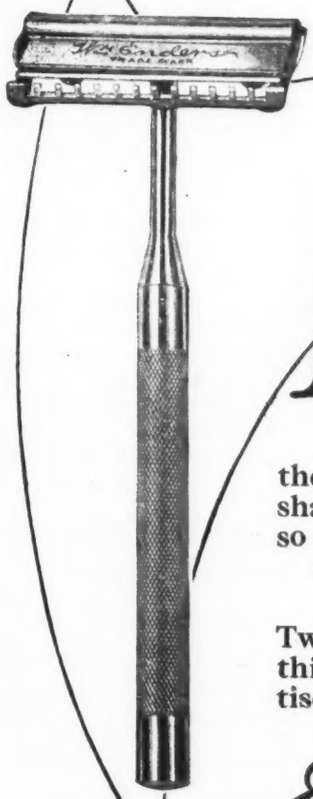
When the roost is filled, it settles down against the springs and the catch can be shoved over the closed door.

But when the fowls jump off in the morning, the springs raise the roost sufficiently to make it pull on the cord and release the catch. Then the counterweight pulls up the door and the fowls are at liberty to go out into the yard and catch the early worm.—L. B. ROBBINS.

"SHAVE:

To make bare or smooth by scraping."

STANDARD DICTIONARY



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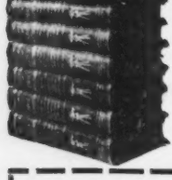

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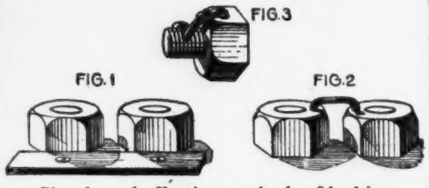
Three Suggestions about Locking Nuts

IT is a well known fact that even a tight nut if subject to vibration will work itself loose. This condition often is dangerous and all kinds of locking devices have been tried, some simple, some elaborate, to overcome this loosening.

The illustration shows three very simple and practical methods of locking that are worthy of attention. Figure 1 is very simple. Tighten the nuts down, then place a flat strip across the faces, and screw the strip to the



Simple and effective methods of locking single nuts or a pair are here shown

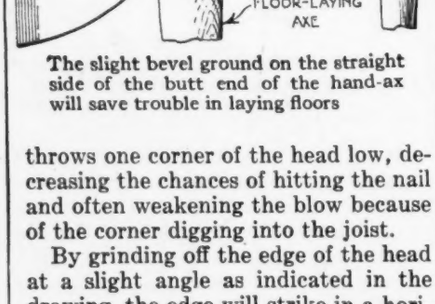
work itself. Should this be impossible, owing to the nature of the piece, use Fig. 2 method. In this case drill two small holes, one in each nut. Then insert a pin of the same size bent to suit the holes and tap it in with a hammer.

The third idea looks harder than it really is. Merely drill a hole at the end of the stud or bolt, insert a small pin, and bend it as shown. As the pin is small in diameter, say 3/32 in. to 1/8 in., it is easily bent.

Try these schemes; they are simple and practical.—J. H. MOORE.

How to Improve a Hand-Ax for Laying Flooring

WHEN laying flooring, a hand-ax is more useful than a hammer because its greater weight draws the boards together. However, the natural tendency of the ax to strike at an angle



The slight bevel ground on the straight side of the butt end of the hand-ax will save trouble in laying floors

throws one corner of the head low, decreasing the chances of hitting the nail and often weakening the blow because of the corner digging into the joist.

By grinding off the edge of the head at a slight angle as indicated in the drawing, the edge will strike in a horizontal position, thus materially expediting the work of putting down a floor.

The illustration shows an ax for use in the right hand. A left-handed man would, of course, grind off the opposite corner.

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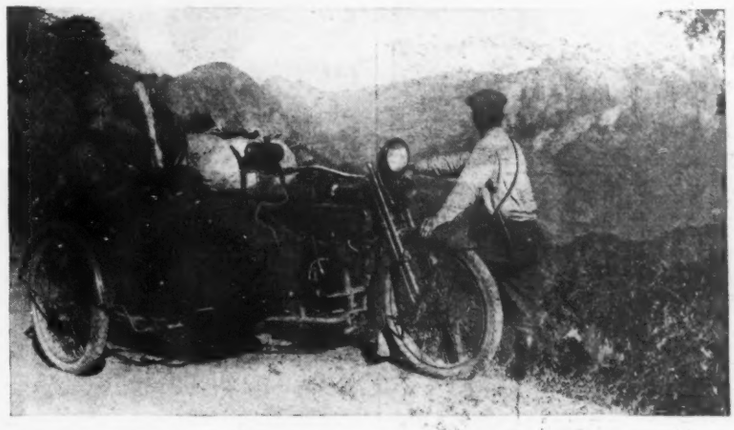
A 4½-in. piece of ⅛-in. brass pipe is used for the upright, and it is first polished, then lacquered. The upper part is threaded to fit the socket and a ¼-in. hole is drilled through one side of the wall to bring the wires through. The standard or base is made of oak with a ⅜-in. hole drilled in the center in which to fit the upright when assembled. Finally glue a piece of felt to the bottom to prevent scratching.

The brass shade can be purchased in any electrical store, with clips attached to fit the bulb. When completed and ready to assemble for use, this lamp consists of only three parts.

Bleach Your Piano Keys with Paste

PIANO keys turn yellow because they absorb the grease from the fingers, and to cleanse them it is necessary to remove this. The value of the method here described is further enhanced by the fact that it does not necessitate the removal of the ivory from the keys. A paste made of whiting and a solution of potash is laid on them, and the mixture allowed to remain undisturbed for about a day. After the dry coating has been removed, it will be found that the original whiteness has been nearly restored.—HERMAN NEUHAUS.



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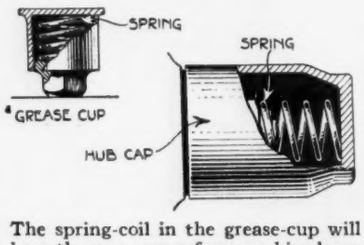
Preventing the Loss of Grease-Cup Covers

SCREW-CAPS of grease-cups are very frequently loosened and unscrewed by the vibration of the automobile and eventually drop off and are lost on the road. This annoyance may be prevented by placing a piece of coil-spring inside the cap as shown in the illustration. The spring will not interfere with the flow of the oil or



The spring-coil in the grease-cup will keep the screw cover from working loose

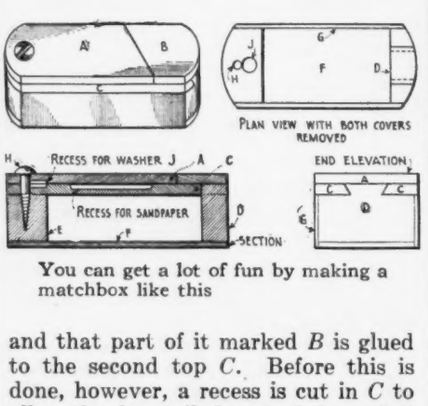
grease, but will tighten the screw-cover sufficiently to prevent it from becoming loose. In a similar manner the loss of a loose-fitting hub-cap may be prevented by placing a section of valve-spring inside the cap before screwing it on.—G. A. LUERS.

How to Make a Puzzle Match-Box

THE original box came from the Paris Exhibition of 1887 or thereabouts. I have made several since then and only found one person who knew how to open it and that was because he had seen one before and knew about it. The drawings and description will enable any one to make one without any difficulty.

The following parts are required: 1 top *A*, 1 top *C*, 1 end *E*, 1 end *D*, 1 bottom *F*, 2 sides *G*, 1 screw *H*, and 1 washer *J*.

The top *A* is sawed across on the angle as indicated on the outside view,



You can get a lot of fun by making a matchbox like this

and that part of it marked *B* is glued to the second top *C*. Before this is done, however, a recess is cut in *C* to allow the dovetailed part of the end *D* to enter. The principal dimensions are about 3 in. long by about $1\frac{1}{8}$ in. wide by about $\frac{3}{4}$ in. deep.

No nails should be used, but the sides, ends, and bottom should be glued together and clamped tight while the glue is setting.

To open the box, hold it inverted in the hand and with the small finger

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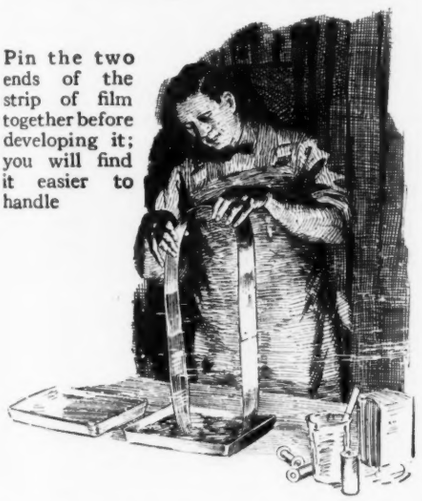
swing out the top *A* at right angles to the box. When the box is inverted, the lead washer *J* drops from the recess in top *C* into the recess in top *A*, and when top *A* is swung around at right angles, the washer goes with it. The box can now be held right side up and top *C* can be pushed along until it clears the dovetailed part of end *D*, when it also can be swung around to either side and the box is opened.—JOHN TANNAHILL.

Avoid Trouble in Developing Strips of Film

A MOTION-PICTURE engineer of the Western Telephone Company suggests a method of developing films which is of equal interest to amateurs and professionals. Every amateur has had the experience of trying to develop a six-exposure postcard film by the usual method of holding it by the ends and drawing it forward and backward through the developing fluid and having one end or maybe both slip from the fingers, to the detriment of the film.

Occasionally the photographer begins to develop what he believed to be



Pin the two ends of the strip of film together before developing it; you will find it easier to handle

a six-film roll, when he finds to his dismay that the roll contains ten pictures, and cannot be manipulated without placing the developing-tray on the floor.

The inventor of the method here suggested solved the problem of avoiding these difficulties, by pinning the two ends of the roll of film together to form a continuous belt. This can be held at the edges between the fingers and the thumb of one hand while the other draws it through the developing solution. The emulsion side of the film should be on the inside of the belt in order to avoid scratches and abrasion marks from rubbing on the tray.

Another method suggested by the same inventor consists in mounting the film-spool above the developing-tray at a height so calculated that the strips of film, pinned together and looped over the roll with the film side out, would just be submerged in the developer without touching the bottom of the tank.—J. B. LAMBERT.

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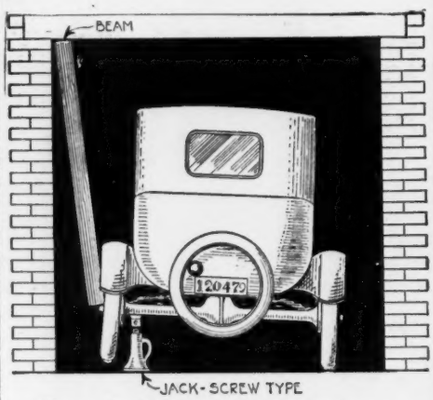
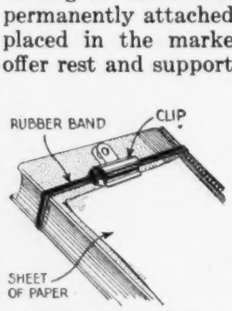


Brace the hub against the door-frame and with a jack straighten the bent axle-shaft in a few minutes

An Emergency Writing-Rest and Paper-Holder

FOR the convenience of those who are at times compelled to do much writing on loose sheets, boards with permanently attached clips have been placed in the market. The boards offer rest and support for the hand in writing and the clips hold the papers in place.



With this contrivance any book may become a paper-rest

It is not always convenient to carry one of these board-clips around from place to place. It is an easy matter, however, to improvise a paper-rest and sheet-holder by pressing into service any available book with a stiff cover. All that is required is a stout rubber band and one of the paper-clips that are used in offices for fastening together bills and documents.

The illustration shows clearly how the clip is attached to the book to hold the writing-paper in position. The same rubber band may be used to hold the papers together for greater convenience in carrying them.

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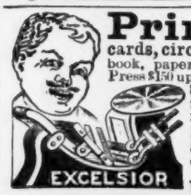

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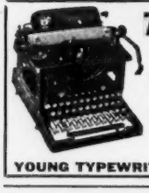

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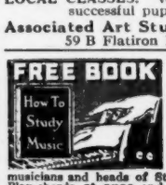

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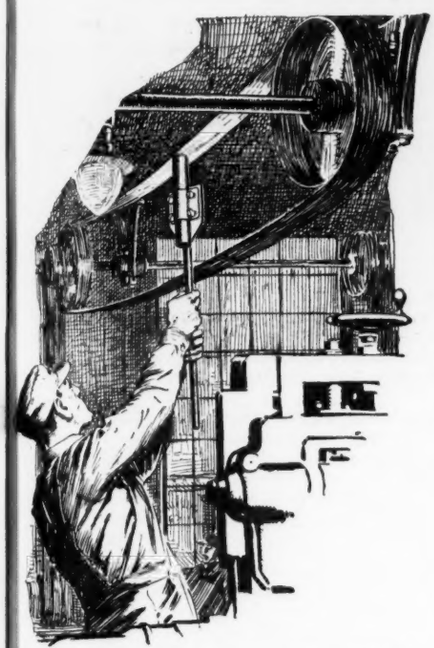
How to Dress an Overhead Belt Safely

A DEVICE for applying dressing to overhead belts to prevent them from slipping is made of a piece of wood, 4 in. wide, cut to the shape shown in the picture.

The clamp is made of a piece of heavy tin bent as shown, with four holes to correspond with four holes in the board. The dressing is put up in a round tube of heavy cardboard, about 10 in. long and 2 in. in diameter. The clamp is made to fit over the tube as shown in the illustration, with sufficient space between the clamp and the board to allow the clamp to tighten on the tube by turning the four small thumbscrew bolts.



Overhead belts may be dressed without risk of accident with the aid of the dressing-stick here illustrated

This tool will be found very useful, as it is often difficult and dangerous to reach overhead belts with a ladder. The belting is in many cases neglected because of the lack of some handy tool for dressing the belt.

Cleaning the Type on a Typewriter

THE method usually employed to clean the type on a typewriter is far from satisfactory. Quite by accident the writer found that benzine will clean the type so well that the original brightness is restored, no matter what the previous condition of the type.

Sharpen a stick to a blunt point, and nick the pointed portion. Wind a little absorbent cotton around it to form a small wad. Immerse the cotton in benzine, and go over the type gently. The cotton absorbs the dye, and a clean metal surface is the result.

Care should be taken to avoid touching enamelled parts of the machine.—HERMAN NEUHAUS.

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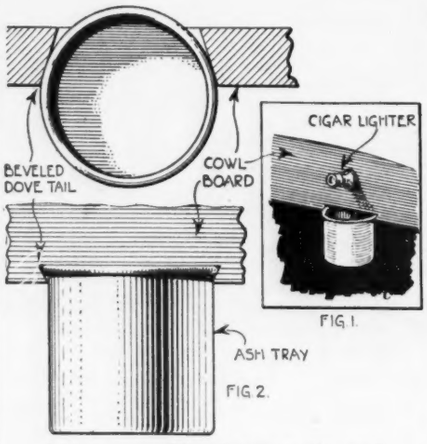
An Ash-Tray on the Cowl-Board of the Automobile

THE accompanying illustration shows how to build a simple and efficient ash-tray to fit the cowl-board of any automobile that has a cowl made of wood. The car selected for the experiment had an electric cigar-lighter mounted in the cowl, attached to a flexible cord, to be pulled out when needed. While the cigar-lighter



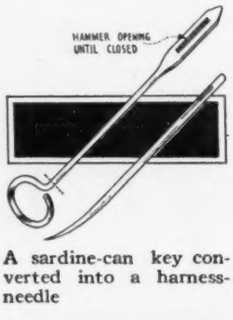
Add a removable ash-tray to the cowl-board of your automobile. Friends riding with you will appreciate this accessory

was undoubtedly convenient, the occupants of the rear seat were invariably showered with ashes every time the occupant of the front seat lighted his cigar. For that reason an ash-tray was considered desirable.

The tray used was one of the aluminum cups with a bead on the edge that are sold in the ten-cent stores. A beveled dovetail slot was cut in the bottom of the cowl-board to hold the ash-tray in place. The tray fitted snugly into the cut, but could easily be taken out for emptying it. It never rattles and will hold the ashes of many smokes.—W. BURR BENNETT.

Making a Harness Needle from a Can Key

ONE day, having occasion to use a harness needle, I found that I had lost the needle and could not obtain another that day. I took a key such as is used to open sardine-cans and cut it off below the curved end that serves as the handle.



A sardine-can key converted into a harness-needle

Inserting the tip of a screwdriver into the slot, I hammered the side of the slot near the handle part until it was quite closed. I filed the cut-off end to a point, curving it a little, and thus obtained a very serviceable needle.

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POPULAR SCIENCE MONTHLY
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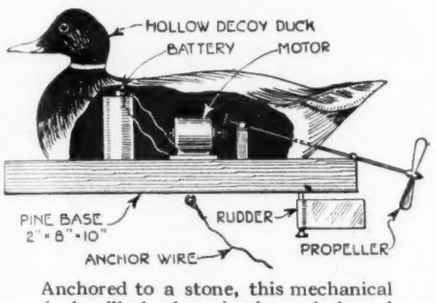
Make a Mechanical Decoy Duck

DUCK-HUNTING requires the use of some kind of decoys, preferably live ducks that have been hatched from wild-duck eggs. To keep a pair of live decoys is a great inconvenience, for they must be fed and housed the year round. Hence this mechanical swimming duck proves a boon to the duck-shooter and he may readily build it for himself.

The body of the mechanical duck should be purchased at a sporting-goods store and should be constructed of either tin or wood. This is the type of artificial duck used in making a stool of decoys. Inside this duck is placed a small electric motor and battery



Anchored to a stone, this mechanical duck will slowly swim in a circle and prove a good decoy for wild ducks

that will run a tiny propeller and so make the duck swim.

The only difficulty that confronts the builder is the fact that the weight of the motor and battery tends to pull the duck too low in the water. Also water gets inside the duck and wets the electrical apparatus.

To avoid this difficulty the artificial duck should be mounted on a pine-wood base 2 in. thick, shaped something like a boat, 8 in. wide, and tapering to a point at the front, being 18 in. in length.

Use a Toy Motor

The motor used is of the toy type, 2 in. in height, and the battery is the ordinary one-cell dry battery. The motor and cell should be mounted on the base first. The propeller is 2 in. long and shaped from tin. It is held on a wire shaft 12 in. long. A set screw in the rear end of the base acts as a bearing, and a support post holds the other end of the shaft with a similar bearing. A cotter-pin holds the shaft from sliding in its bearings.

The upper end of the propeller shaft should carry a small belt pulley that will be held in line with that on the motor. This pulley should be four times the diameter of the pulley on the motor. When the driving machinery has been installed so that it balances nicely on the base, the bottom of the artificial duck should be cut away so that it will fit over the machinery and it is then secured in place by 4 screws.

A small propeller at the rear end of the base will be useful in causing the duck to swim about in a circle. This

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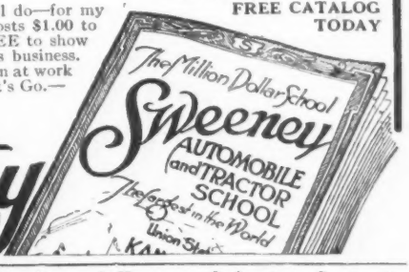

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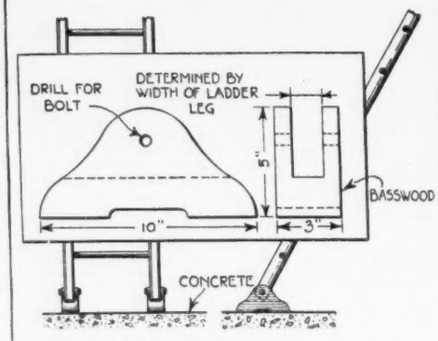
is also arranged for by the anchor. This mechanical decoy is anchored in the ordinary way and when the motor is connected with the battery it will cause the duck to keep swimming round and round slowly in a circle. A pair of these mechanical ducks in front of a blind will work wonders in coaxing in the wild ducks.—F. E. BRIMMER.

How to Keep a Ladder from Slipping

LADDERS that are used in places where they rest on concrete or other smooth floors frequently cause accidents by slipping. Ladders with pointed foot-ends are safe on soft



Safety from slipping on concrete or other smooth floors is given to ladders by providing them with basswood feet

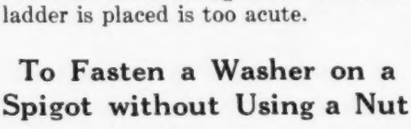
ground, but give no security on smooth and unyielding ground.

Ladders intended for use on smooth floors can be made safe only by increasing the friction, which can be done by giving to the supporting feet a larger area of contact with the floor.

The illustration shows a simple method of increasing the safety of the ladder. The blocks on which the ladder rests have a bearing surface of 19½ sq. in. each, which in most cases is sufficient to prevent slipping accidents unless the angle at which the ladder is placed is too acute.

To Fasten a Washer on a Spigot without Using a Nut

TO hold a washer on a washer-post that has lost its nut, or the thread of which has become worn, file a slight recess around the post where it joins the seat, then use a washer



File a recess in the post and even when the nut is lost the washer will hold

which has been cut out of an old automobile tube, heat a wire nail of appropriate size, and burn a hole through the rubber. The rubber washer can then be forced on the post without difficulty and will be held in place by being pressed into the recess.

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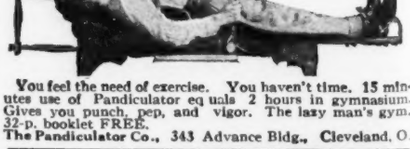

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A Plummet for Measuring Specific Gravity

IT is often convenient to ascertain the specific gravity of a liquid by weighing a solid in water and in the given liquid instead of using a specific gravity flask or a hydrometer.

A small plummet suitable for this purpose may be made from a glass tube partly filled with mercury and sealed by drawing out the glass and bending into a loop for suspension. Keep the plummet in a cardboard tube, noting on the outside the exact weight in air

Chemists will find the use of such a plummet a short cut in making specific gravity determinations

and the loss of weight in water—the difference between the weight in air and the weight when completely immersed in pure distilled water at 15½ degrees.

To take the specific gravity of a liquid, weigh the plummet in the liquid, at standard temperature, and subtract from the weight in air. This difference divided by the loss of weight in water gives the specific gravity.

This Glass Cement Is Water-Resisting

BY following the process described below, a cement may be prepared which completely resists the solvent action of water. The inferiority of the cements on the market for cementing glassware lies in the fact that most of them dissolve in water, making them invaluable to the user for even ordinary purposes.

Seven parts of a pure, dry gelatine should be dissolved in a hundred parts of distilled water. To the resultant mixture add about one part in ten of a concentrated potassium dichromate solution, and keep it in the dark for future use. After the article has been cemented and a good joint made, the cement becomes hard when exposed to the light for a short time. The joint so made will be strong and impervious to water.—HERMAN NEUHAUS.

Use 20 Times

Then see how your teeth improve

This offers you a ten-day test of a new teeth-cleaning method—enough for 20 uses.

Each use will bring five much-desired effects. See how your teeth conditions change after ten days' use.

A film combatant

The great object is to fight film—the cause of most tooth troubles.

Film is that viscous coat you feel. It clings to teeth, gets between the teeth and stays. The tooth brush, used in old ways, leaves much of it intact. So millions of teeth are dimmed and ruined by it.

Film absorbs stains, making the teeth look dingy. It is the basis of tartar. It holds food substance which ferments and forms acid. It holds the acid in contact with the teeth to cause decay.

Germs breed by millions in it. They, with tartar, are the chief cause of pyorrhea.

Now a new era

Now dental science, after years of research, has found ways to fight film. Able authorities have proved their efficiency. And leading dentists everywhere now advise their daily use.

The methods are combined in a dentifrice called Pepsodent. Millions now employ it. And to their homes it has brought a new era in teeth cleaning.

Watch these five effects

Each use of Pepsodent brings five desired effects. The film is attacked in two efficient ways. The teeth are so highly polished that film cannot easily adhere.

Then it multiplies the salivary flow. It multiplies the starch digestant in the saliva, to digest the starch deposits which cling. It multiplies the alkalinity of the saliva, to neutralize the acids which cause tooth decay.

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See what this means. Send the coupon for a 10-Day Tube. Note how clean the teeth feel after using. Mark the absence of the viscous film. See how teeth whiten as the film-coat disappears.

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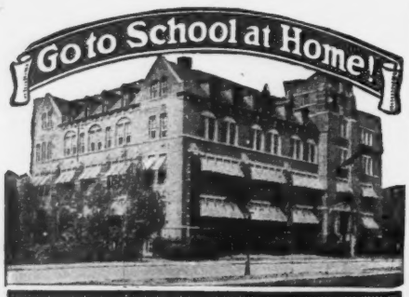

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How to Make Your Own Smoking-Stand

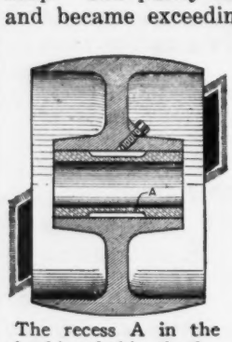
THE stand shown herewith is a real convenience to one who likes to smoke and read. It is made of ½-in. stuff and finished in dark oak. After truing your boards, mark the diagram to be followed on a piece of paper and use the latter as a pattern to get your lines on the wood. Nearly all the cutting can be done with a saw of ordinary size. Running up and down in the corner joint, you might glue a

Every smoker who likes to smoke and read will appreciate this little stand

1-in. convex quarter mold. The top extends over the sides 1½ in. and is 10 in. square. It is held in place by means of the little fittings called table-top fasteners.—H. ADLON.

Lubricating a High-Speed Loose Pulley

SOME time ago we had considerable trouble with a loose pulley in our shop. The pulley ran at high speed and became exceedingly hot because it could not be lubricated properly. The trouble was remedied by enlarging the bore of the hub sufficiently to admit a bronze bushing that was recessed as shown in the illustration to about five-eighths the length of the hub and to the depth of 3/16 in. Several small holes were drilled through the face of the bushing and, before it was pressed into the hub of the pulley, candle-wicking was wound loosely in the recess. Oil was injected into the recess through a hole closed by a screw. The wicking absorbed the oil and fed it to the shaft.



The recess A in the bushing holds the lubricator

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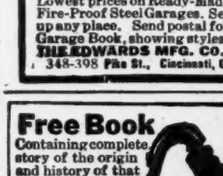

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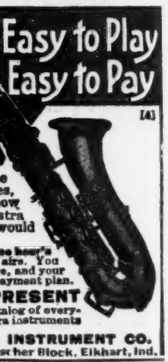

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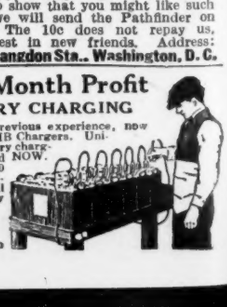


Hobart Brothers Company
Box S3377 Troy, Ohio

Turning a Packing-Box into a Bread-Raiser

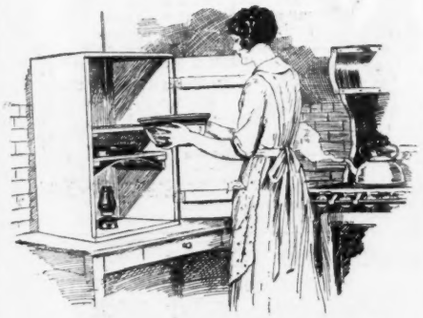
IN making bread the housekeeper often finds it difficult to keep her sponge or dough at the right temperature so that it will rise in the shortest possible time. She will find a sponge-box or bread-raiser such as shown in the illustration a great help. A box like this can be made easily from an ordinary dry-goods packing-box. A box 26 in. by 20 in. by 20 in. is a convenient size.

About 10 in. from the bottom of the box a shelf made of slats or strips of wood rests on cleats fastened to the sides of the box. A second shelf is placed 4 in. from the lower one. Both shelves can be removed when it becomes necessary to clean the box.

Below the lower shelf a sheet of galvanized iron slightly wider than the shelf is inserted. It is curved in order to make it slip in and stay in place securely.

This iron prevents the scorching of the lower shelf when the lamp is placed below it, and also helps to distribute the heat more evenly.

The door is hinged and fastened with a thumb-latch or hook and staple. Several small holes are bored in the lower and upper parts of the sides and in the top of the box to promote the circulation of air. One larger hole, about 1 in. in diameter, should be bored in the top. This hole should be closed with a cork, bored through the center to admit a straight thermometer tube which registers as high as 100 degrees F.



Housewives who do their own baking will find a homemade sponge-box very useful

To avoid all danger of fire the box should be lined with asbestos or tin when a kerosene lamp is used for heating.

If an electric light is used, the lining is not necessary. A 16-candlepower light will heat the box sufficiently.

The bowls of sponge or pans of dough are placed on the top shelf and the temperature of the box should be kept as near 86 degrees F. as is possible.

The temperature in the box may be varied by raising or lowering the flame of the lamp or by using warm or cold water in a shallow pan on the middle shelf.

Stop that Pain!

WHY wait for a severe pain, an ache, a sore, strained muscle, sciatica, lumbago or a rheumatic twinge to make you quit work when you should have Sloan's Liniment *handy* to help curb it and keep you active, fit and on the job?

Without rubbing, for it *penetrates,* just slap Sloan's on the afflicted part. Note the gratifying, clean, prompt relief that follows. Sloan's Liniment couldn't keep its many thousands of friends the world over if it didn't make good. That's worth remembering. Get the largest size bottle for economy's sake. At all druggists.

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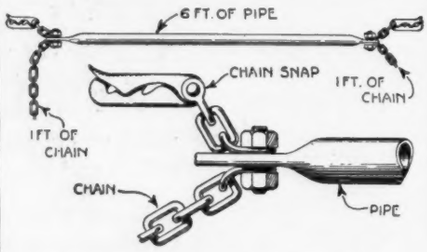
Tow Automobiles with a Rigid Tow-Bar

INVARIABLY when an automobile has broken down in the streets or on the road, the owner of a small garage will send the first available car, equipped with a piece of rope or tire chain that he may have on hand, to the scene of the breakdown to tow in the derelict. The driver of the towing-car has frequently an exciting time, especially when it is necessary for him to drag the broken-down car through city streets with much traffic. When he is compelled to make a sudden stop the towed car will often run into the rear end of the pilot and both cars are damaged.

All this can be avoided if the owner of the garage were provided with a rigid tow-bar for dragging the disabled



Never attempt to tow a disabled automobile with a rope. Use a rigid bar

vehicle through the streets. A rigid bar is by far the best means, as it keeps the two cars at a fixed distance from each other. Regardless of the conditions of the brakes of the disabled car, it will come to a stop when the towing-car stops.

In the accompanying illustration a tow-bar is shown which can be made from a 6-ft. section of 1-in. wrought-iron pipe, 2 short pieces of chain, 2 bolts, and 2 tire-chain snaps. The pipe is flattened at each end, and chains and snaps are attached by bolts through drilled holes in the flattened ends. If no iron pipe is available, a correspondingly heavier wooden bar may be used to the ends of which the chains and harness hooks are attached.—G. A. LUERS.

How to Make an Adjustable and Handy Shootboard

AMATEUR carpenters and marquetry workers usually find great difficulty in laying out angles with any degree of accuracy. An adjustable shootboard with which any angle from 1 to 90 degrees may be laid out will be an extremely useful part of their equipment. The illustration shows how such a shootboard may be made.

The base arm is made of birchwood. The top is screwed and glued to the lower part, leaving a rabbet in which the plane slides.

The arm is slotted 1 in. from the end. The slot is 1 in. by ¼ in., and the arm is fastened by a wing nut and pin as shown in the picture. The slot makes

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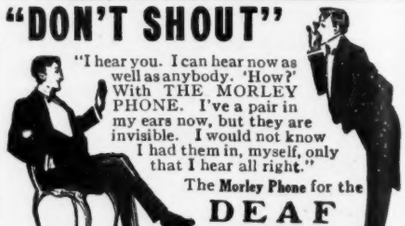

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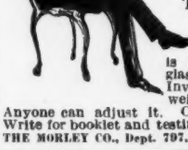

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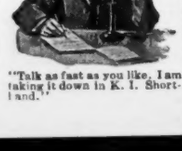

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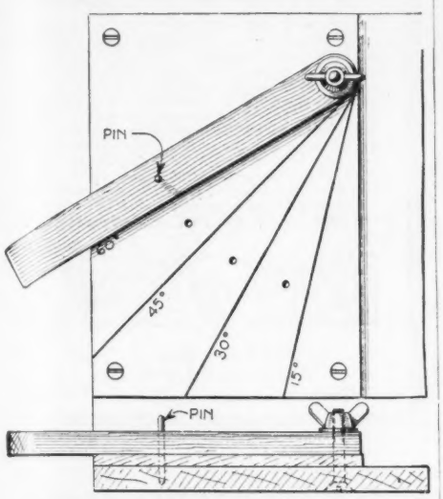
it possible to bring the end of the arm close to the rabbet so as to give a clear-cut straight line across the work being planed.

The pin passes through the arm and into holes bored at the different angle marks and helps to steady it. After the parts have been put together, mark the different angles and make a shallow saw-cut through them. Bore 1/8-in. holes through the arm and at each



Angles may be laid out with sufficient accuracy with the aid of this shoot-board

mark. A large finish nail with rounded point makes a good pin. Be sure when putting together the parts to have a perfect right angle at the rabbet, as this is the most important part. If the angle is not true, the work will not be square.—E. F. TANNER.

A Simple, Efficient Tool for Cutting Concrete

TAKING down concrete work after it has had a few years to "set" is a slow job, as a rule. If it is outdoors, and conditions will permit, the quickest way is to blast the mass; but indoors, of course, this cannot be done, and it becomes a question of the most efficient tools. If compressed-air service is to be had, pneumatic chipping hammers are the quickest tools for the job, fitting them with proper chisels for this work.

A point gives the chisel great penetrating power

For hand chipping and breaking up of a concrete mass the diamond pointed chisel shown will penetrate farther than any other. This means more splitting up of the concrete an hour, or, what is the same thing in the end, the same amount of work with less fatigue. For heavier work, "handle chisels" may be so shaped—one man holding the chisel and another driving with a sledge. Of course, like all tools, the wear on it will be greater as the concrete is older.

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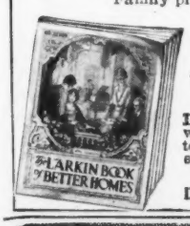

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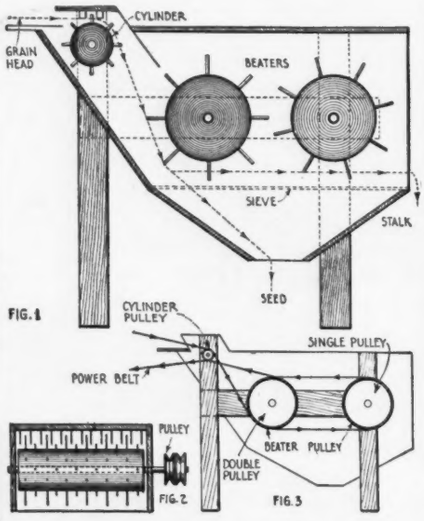
A Small Grain-Thresher for Practical Use

THE following description of a small grain-thresher which I constructed when I was a mere lad, and which proved to be of service on the farm, may be of interest.

For a cylinder I cut one foot off the end of a wooden roller 3 in. in diameter. The teeth were nails driven spirally about the cylinder, in rows that alternated with similar teeth in the concave, the rows of teeth being driven about ½ in. apart. The beaters were larger rollers in which were set wooden teeth. To hold the cylinder and two beaters in place 4 upright posts and 2 cross-beams were used as shown in the illustration. The dimensions of the completed thresher were about 2 ft. high, 14 in. wide, by 3 ft. long. The mesh of the sieve was



The grain-thresher shown here was of practical use for threshing grain and seed-bearing flowers

just right to let seeds fall through while the stalks (off which the cylinder had knocked the seeds) were kicked out the rear by the beaters.

The power that I used to run my thresher was an 8-ft. windmill that I constructed, using a buggy wheel for the frame. The cylinder must be run at a fairly high rate of speed, while the beaters can be run much slower. The size of pulley on each will determine the speed.

The thresher-cylinder has a double pulley. One of them is connected by a belt with the driving power, while the other transmits the power to the large double pulley of the nearest beater, which is belted to the other beater and rotates in the same direction. A single pulley only is required for the second beater roller.

It is better to put only the heads of grain into the thresher, as the long stalks would be apt to twist about the rollers. I have very successfully cleaned buckwheat, oats, wheat, and also seed from many different kinds of flower-pods.—F. E. BRIMMER.

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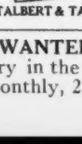

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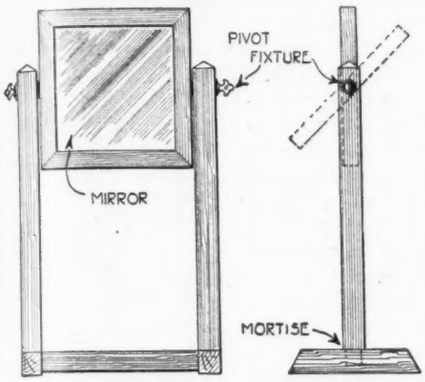
How to Build a Shaving-Glass for the Dresser

THE illustration shows a simple and effective mounting for a small mirror. The material used is 2 in. square. The two pieces that form the main part of the base are bevelled at each end. Their length is 8 in. The length of the crosspiece that connects them is governed by the width of the mirror you are using. The crosspiece



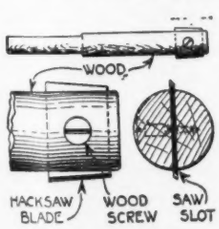
Follow the directions and you will have little difficulty in making one of these mirrors

is fitted flush to the base pieces and is fastened by screws driven obliquely from the under side. The posts are pointed at the top and mortised at the bottom. Metal fixtures may be purchased for a small sum. The mount should be finished in dark oak and two coats of waterproof varnish.

Improving a Reamer in an Emergency

A VERY useful emergency reamer can be easily and quickly made from a stick of hard wood, a piece of hacksaw blade, and a short wood-screw.

The piece of hard wood (hickory preferred) should be turned down until it will just turn easily in the hole that is to be reamed, and should be long enough to allow one end of it to be inserted into the drill-chuck or carpenter's brace.



A piece of hacksaw blade and a stick make this reamer

At the other end a slot should be sawn with a thin hacksaw. This slot should be deep enough to allow the saw-blade to be about $\frac{1}{8}$ in. from the end.

Now take a piece of hacksaw blade of a length to make the proper-sized hole, grind cutting edges on each end of it and insert it in the slot in the position shown. If the cutting edges are ground with a slight taper they will cut and feed better.

A common, short wood screw may be used as a set screw if so desired, although it will not be needed if the blade is made to fit tight enough.

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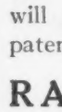

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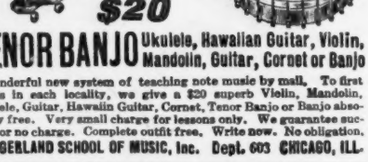

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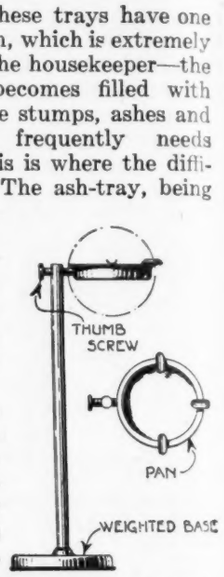
This Smokers' Ash-Tray Is Easily Emptied

THERE is a large variety of smokers' stands on the market, some of wood with brass ash-trays, but the majority of them made entirely of metal.

Nearly all of these trays have one feature in common, which is extremely inconvenient for the housekeeper—the ash-tray which becomes filled with cigar and cigarette stumps, ashes and burnt matches frequently needs emptying, and this is where the difficulty comes in. The ash-tray, being irremovably attached to the top of the stand, cannot easily be emptied without turning the whole stand upside down.



It is easy to tilt and empty this ash-tray

If you have one of these stands with a fixed ash-tray, you can easily improve it by changing it as shown in the illustration. If the thumbscrew is released, the tray can be turned upside down and its contents dumped into a bucket. One or two turns of the thumbscrew will fasten the ash-tray in its resting position and hold it firmly until it is again necessary to empty it.

Straighten the Axle with the Jack

ON my car the front axle was sprung, so I took it out, but not having the proper tools for straightening it, I was up against it until I thought of this plan: I found a part of an old railroad rail and set it up with

With only an old rail, a jack, and some chain, a bent axle was quickly straightened

a block under each end. I then took a jack out of the car, set it on the rail and put the bent part of the axle on the jack and chained the ends to the rail.

The axle was thus very easily straightened.—ROBERT HOLVEY.

Constructing a Steaming-Vat at Home

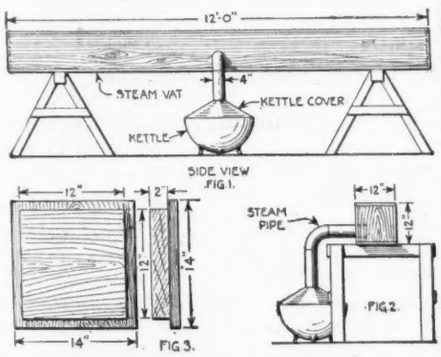
IN building motor-boats and canoes, it is necessary to bend the ribs and planking to shape, and very often considerable trouble is experienced in doing this. Soaking the material in water will answer where it is not to be bent to any extent, but in bending ribs for canoes and model hulls, it is necessary to steam them so as to bend them properly.

In the accompanying illustration is shown a steaming vat that can be easily constructed. The vat is so simple, that at a single glance one may readily understand its construction.

First procure a couple of trestles such as are used by carpenters. They are usually from 2 to 3 ft. in height. Next make a box 12 in. by 12 in. by 10 ft.

If ribs are to be steamed, the box may be made longer to suit the work. The box should be left open at one end to receive a plug. A hole 4 in. in diameter is then bored in one side of the box, to receive the pipe from the kettle.

The next step is to make the funnel cover for the kettle. This funnel may

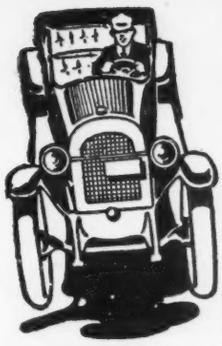


Amateur boat-builders will find it advantageous to build a steaming-vat for bending rib timber

be made of galvanized iron. No dimensions are given, as the size depends upon the size of the kettle. However, the pipe conveying the steam to the box should be about 4 in. in diameter, so as to allow free passage to the steam. The kettle should be placed about 4 ft. to one side of the box. A discarded gutter-pipe and elbow will answer the purpose.

A few strips of wood, about 3 in. thick, should be nailed to the bottom of the box to prevent the material from resting on the bottom and thus preventing the circulation of steam. The kettle should be nearly full of water, and the material placed into the vat before the fire is started. Do not steam too many pieces at one time, also see that the plug is tightly fitted.

The time required for steaming can only be determined by occasionally testing the pieces until they are found to bend easily. You will find that material that has been steamed in this vat can be bent to almost any shape.—O. B. LAURENT.



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Old Automobile Seats Make a Porch Swing

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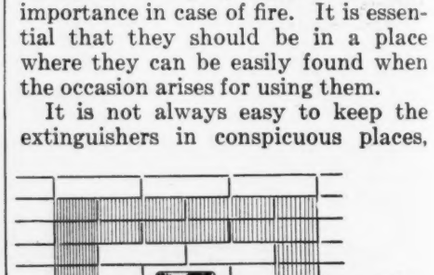
This comfortable porch swing cost four dollars and a little work; can you do better?

and 4 in. wide. These were provided with bolts at the end which had been bent into the form of eyes at the upper end and a small chain from each runs to a single hook at each end in the ceiling. This swing affords more comfort than many now on the market, and was made at a total cost of about four dollars.—DALE R. VAN HORN.

Paint a Border Around the Fire-Extinguisher

IN every factory, repair-shop, or garage there should be kept at all times an adequate number of fire-extinguishers. They are of the utmost importance in case of fire. It is essential that they should be in a place where they can be easily found when the occasion arises for using them.

It is not always easy to keep the extinguishers in conspicuous places,



Paint a bright red border on the wall to mark the fire-extinguisher's whereabouts

especially in shops with limited floor area and with a large accumulation of material and machinery. It is an excellent plan always to keep them in the same place, which should be easily accessible at all times, and to mark this place by painting a border of vivid red around it. Even in dim light, the border will attract attention to the extinguisher.—G. A. LUERS.

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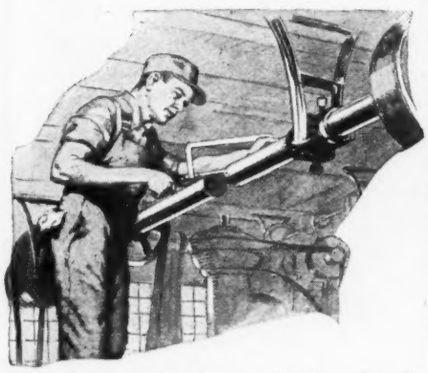
Repairing a Broken Large Line Shaft

A BROKEN line shaft in our shop had to be repaired without delay. It was 6 in. in diameter and was driven by an engine of 350 horsepower. The break was directly under a large steel split pulley, doubtless from a flaw in the steel. Had it been possible to change the position of the pulley, the repair could have been made easily by connecting the two broken ends with a split coupler, but the pulley could not be moved to any other position.

To remedy the situation, it would have been necessary to slide the entire line shafting to one side or the other. This would have necessitated shifting the positions of probably one hundred other pulleys on the 150 ft. of shafting,



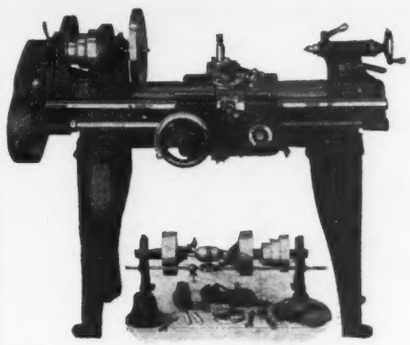
This illustrates the clever method employed for repairing a large broken line shaft

or taking out the broken section of 16 ft. and replacing it with a new one, which would involve considerable cost.

Upon the advice of the writer, the following method was employed and it gave perfect satisfaction. First, the broken ends of the line shaft were cut off square and smooth with a hacksaw. Then the two ends were swaged apart so that a hand-drill with chuck and drill could be placed between the ends. The drill was placed lengthwise to the shaft end and braced in line.

A 2-in. hole was drilled into each shaft end to a depth of 4 in. and tapped. Then an 8-in. piece of steel shafting, threaded to fit the threaded holes of the shaft ends, was screwed equal distances into the two parts of the shafting until the ends were tight against each other. To give to the joint additional strength, a hand key-seating machine was used to sink a keyway on each side of the joint, 1 in. wide and 1 in. deep, and two steel keys were sunk into these slots almost flush with the surface of the shafting. Then the split pulley was put back to its place over the joint and all gripping bolts were screwed tight, reenforcing the joint as well as holding the pulley in place.

I might add that the threaded plug was wetted with muriatic acid before it was screwed into the shaft ends. The object of this was to cause rust to form, which in time would cement the parts together.—R. C. LEIBE.



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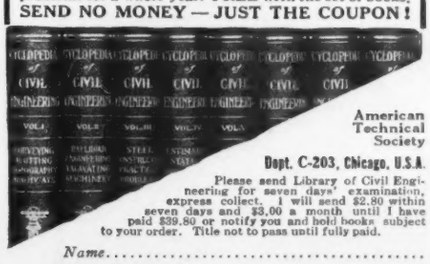

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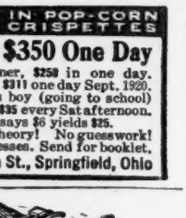

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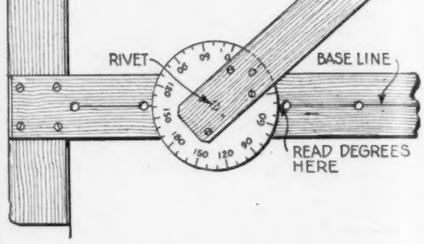
How to Construct a One-Operation Protractor

IN drafting it is always a loss of time to use a protractor, especially the simple semicircular one, which is usually the only one available for the amateur. It has to be located on the indexing point and at the same time true to the direction of the drawing; after all this shifting the point is made at the proper angle, a straight edge has to be placed to coincide with the two points and finally the line is drawn.

To make a protractor that will fill all the above requirements in one operation use the T-square with a line drawn exactly in the middle; then at 2-in. intervals bore holes of the same diameter as the pin used in the center of the protractor, preferably ⅛ in.

Cut a 4½-in. circle from heavy sheet metal, laying off the degrees



Draftsmen who frequently use a protractor will find that this instrument will simplify their work

with a cold chisel. Numerical steel dies can be used to designate enough of the scale so that the graduations may be easily read, every ten degrees being the usual method.

In the exact center of the circle that was established by the compass when laying off the circumference (before the metal was cut) bore a ⅛-in. hole, inserting a rivet of about ⅛ in. in length. This is used to fit into the holes along the base line on the T-square whenever you are using the protractor.

Next fasten a 12-in. rule, causing the imaginary line through the middle of its width to fall exactly over the 0° and 180° graduations as shown in the illustration.

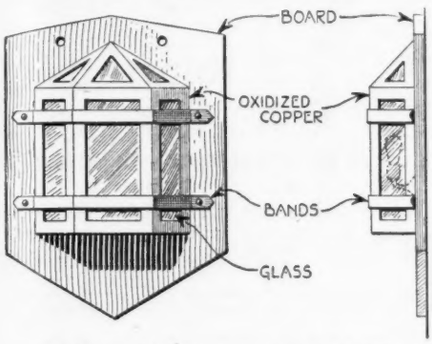
This can be accomplished most accurately by measuring the width of the rule, then scratching two lines across the face of the protractor the same distance from a line scratched between 0° and 180°.

To use the protractor, insert the rivet into the hole that lies just under the drawing, placing the pencil on the point from which the line is to be drawn; with the other hand turn the protractor to the desired angle, sliding the T-square up until the rule touches the pencil, then draw the line.—J. ALEXANDER.

An Artistic Lamp for Den or Porch

HERE is illustrated a simple and attractive lamp which amateurs can make. Roughly stated, it is a framework or housing of sheet metal, with glass, mica, or transparent paper in the panels. The lamp, candle, or electric fixture to be used will determine the size of the enclosure.

The first part of the work is to cut out a wallboard like the one shown from 7/8-in. cypress, and fasten to it a half-hexagonal shelf for your lamp to



Easily made and yet ornamental is this wall lamp, which is suitable for den or porch

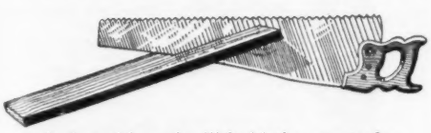
rest on. The shelf will also shape the lower end of the metal housing.

One piece of oxidized copper is the best to work with. Draw your diagram on the reverse side and cut out the panels with a sharp cold chisel and snips. Smooth the raw edges with a file. Bend to the shape you desire and fasten to the board with round-headed screws.

The top or dome-shaped piece is made separately and fitted so that it can be lifted off. It has no mica in the center panel, as some escape of heat is essential. The lighting member is put in and taken out through the top opening.

How to Set a Saw with a Board

SETTING a saw, especially a fine one, is usually an awkward operation and particularly trying when working on the left side and you have to hold the saw by its nose with the



A ripped board will hold the saw to be set almost as securely as a saw clamp

left hand while working the set with the right.

Take a board 6 or 8 in. wide and 2 ft. long and rip 5 or 6 in. into one end. Place the saw into the cut and the other end of the board under you on the chair or bench where you sit. The saw will be held perfectly rigid sideways and can be slid up and down easily. There is no trouble setting a saw this way.—HENRY SIMON.

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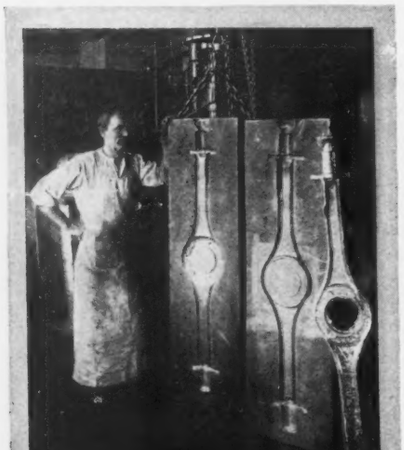

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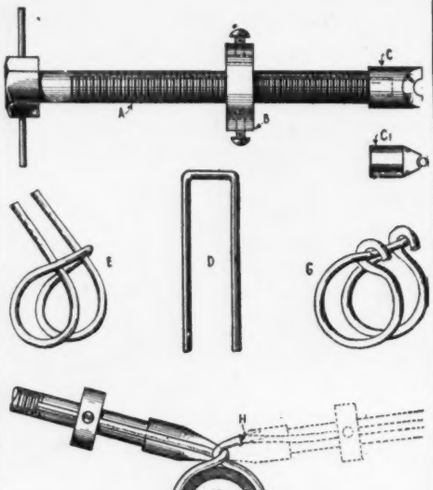
A Tool to Bind Couplings of Hose-Pipes

THE accompanying illustration shows a tool for binding couplings of hose-pipes which I made for my own use and which any one who has need for such a tool may duplicate by following the directions given. *A* is a hexagonal-head screw, 4 in. long and ½ in. in diameter, with the threads filed off at the end.

This should fit the socket *C*, which is made of a piece of ⅛-in. gas-pipe, the end of which is filed to a point as shown and is grooved to fit the binding wire.

A small piece of iron is *B*, drilled and tapped to fit the screw *A*. On each side of this nut are drilled small holes for the binder wires and on the ends



Soon your garden hose will need mending and recoupling. Provide yourself with the right tool

are holes drilled and tapped for the set screws to hold the binder wires while the tool is in operation.

To use the tool, take a piece of hay-baling wire and bend it as shown in *D*, wide enough to fit over *C*, and the ends of the binder. The ends of *D* must be long enough to pass around the hose and into *B*, which will then be formed as shown in *E*.

Now place the wire form over the hose, putting the coupling in place and attach the tool as shown in *F*. The closed end of the staple shown in *D* should rest in the groove of part *C*.

The two ends of the staple should be fastened in the holes drilled through the nut *B*. *B* should be brought down close to *C* and the set screws tightened in the two wires. Then the screw *A* should be turned until the binder is taut, then turned over so as to loop the ends over the straight part of *D*.

Take off the tool, cut the wires at *H* and hammer them down to a clinch. After a little practice you will have no difficulty in making your couplings tight.—Charles F. Taylor.

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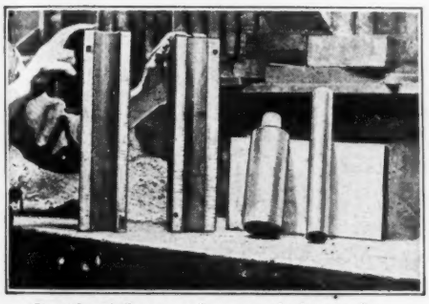
A Simplified Method of Casting Bearing Stock

By David Baxter

WITH the advent of the millions of automobiles, trucks, and tractors comes an ever increasing demand for bearings and bearing-stock metal. For this is one part of machinery in general that receives a very great amount of wear, if not in fact the greatest amount. Bearings are continually wearing out, even on the high grade cars and tractors. And as the number of these machines increases so will the demand for bearings increase. Therefore each and every repair mechanic should know one or more ways to make bearing stock.

Now, there are several different methods employed in molding and casting bearing stock, and perhaps one is no better than another under certain circumstances. But the following described process is no doubt the simplest, surest way for the average mechanic. All of the different sizes of bearings or bushing stock can be made



On the left are the two halves of a core-box; to the right is a pattern ready to be used

this way by merely changing the size of the pattern and core.

All the equipment that is needed can be made at home with but trifling expense. And the work is of the simplest kind. For the sake of clearness let us divide the necessary tools and materials into distinct groups, with a detailed description of each, following this with plainly worded instruction for using each part in relation to the whole method.

The Pattern

Perhaps the chief essential is the pattern, which consists of a piece of wood, preferably white pine, turned in a lathe to the desired diameter and length. To one end of this cylindrical piece of wood is fastened by dowel a smaller cylinder, also of wood. The diameter of this smaller part should be of a size corresponding to the diameter of the hole it is desired to make through the bushing stock. The larger part is called the pattern and the smaller part the core-print.

It is only necessary to have several different-size core prints to enable the mechanic to cast bushings with different-size holes through them; the doweling makes the core-prints detachable. Also there should be a number of different lengths and diameters of patterns, although one pattern may be used to cast several different lengths of bushings. A good coating of shellac varnish will make the patterns work easier and preserve the wood indefinitely. An example of a complete pattern is shown in the center of Fig. 3.

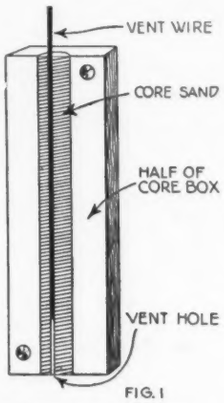


FIG. 1

One half of a core-box is here shown

The core-box is to the left of the pattern in Fig. 3, held upright by the mechanic. It consists of two blocks of wood approximately a foot long, doweled and nailed together, while a hole is bored through them from end to end, half the hole being located in each of the blocks. When the hole has been bored, the two halves of the core-box are separated, smoothed, and polished. The dowels serve as guides in fitting them together when making a core. These core-boxes may be of a variety of sizes and lengths to suit conditions. A heavy coat of shellac now and then keeps the boxes in good condition and serves to release the core more easily.

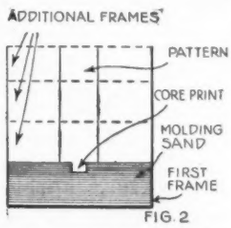


FIG. 2

A vertical section of a mold-box

On the opposite side of the pattern in Fig. 3 is seen a core ready to be used. These cores are made of a mixture of river sand, flour, and oil, and are thoroughly dried in an oven. Any cookstove may be utilized for drying cores.

A good mixture for cores is as follows: 12 parts river sand, 1 part flour, 1 part oil (linseed preferred) thoroughly mixed and run through a riddle and slightly moistened with water.

For the Mold-Boxes

These boxes consist of wooden frames 3 or 4 in. deep by 1 ft. wide and 16 in. long; this excess of size is for the purpose of molding several bushings at one time. There should be several frames at hand for use in making different-length bushings.

Figure 2 of the accompanying illustrations shows the shape, size, and use of the mold-boxes.

In connection with the mold-boxes is used what is termed molding-sand. The name is rather misleading to the layman since it is a mixture of sand and clay thoroughly burned before using. But in the absence of either or both of the ingredients the mechanic may use common earth thoroughly tempered and baked to remove any vegetable matter.

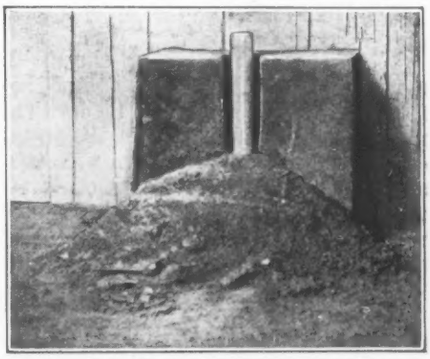
After drying, the molding-sand should be moistened enough to cling in a ball when gently squeezed in the hand, but not wet enough to be muddy. The latter condition will cause the bearing metal to bubble when the mold is poured, resulting in a spongy worthless bearing. A quantity of molding-sand is exhibited in Figs. 4 and 5. If a foundry is near, the mechanic may solve the molding-sand problem by buying a few bucketfuls from the foundryman.

The Necessary Tools

For making a bushing mold the mechanic will need a few hand tools such as hammer, shovel, sieve, bucket, etc. In addition to the hand tools he will, of course, need some equipment for melting the metal. If the bushing stock is to be cast of babbitt-metal, he will need a babbitt-ladle of sufficient capacity. He can melt the babbitt on a forge. But if the bushing is to be cast of brass, he will have to use a graphite crucible. The brass may also be melted on a forge, if it is especially arranged, by building a fire-brick furnace around the fire and using coke for fuel.

Making the Core

The mechanic need not make the core first, but it is probably most convenient to do so. Mix sand in the proportions already prescribed. Do not get it wet enough to be sticky, but add the water in small quantities until the



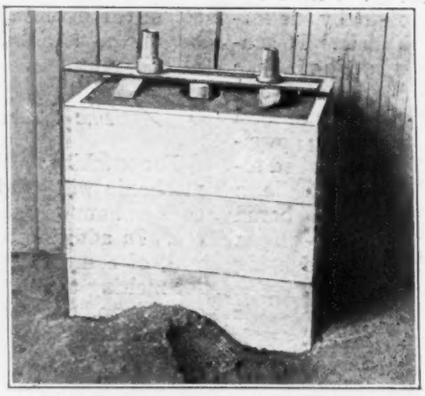
A mold with the frame removed, showing the core in position for casting. In front is a pile of molding-sand

mixture is only moist enough to hang together well. Then clamp the box halves together with common screw clamps and stand it on end upon a smooth bench. Next stand a heavy wire in the center box and put a few handfuls of the core-sand around it. Tamp this down firmly with a rod of

sufficient size to work easily. Tamp regularly and evenly around the wire. Then add another quantity of sand and tamp it around the wire. Then keep adding sand until the box is tamped sufficiently full to make the desired length of core. Then draw the wire out of the sand with a twisting movement, which should leave a smooth hole through the packed sand.

This hole is for the purpose of allowing the core-gas to escape from the core while it is baking and when the molten metal is being poured around it; it is called a vent-hole and should be open the full length of the core. Figure 1 shows a cross-section of the core with the wire partly withdrawn.

Next the core is removed from the box and baked. To do this one half of the box is slowly tilted over an iron plate until the core rolls gently out upon the plate. The plate with the core upon it is placed in an oven and baked until it is a dark brown, almost black. The core-box should be rapped smartly with the tamping-rod before taking off the clamp and half the box, to prevent the wet core from adhering to the form. It will pay the amateur to handle the core with great caution while removing it from the mold and transferring it to the oven. Although defects in the core are not always of serious importance, they may, sometimes, cause the failure of a casting. The crumbling of the sand in the vent-hole may block it and lead to a disruption of the casting by the expanding core-gases.



The complete mold, inclosed in its frame, with the core held in position by a weighted strip of wood, ready for pouring

How to Make the Mold

While the core is baking the mold may be made. First place one of the frames upon the floor and fill it with moist molding-sand. Press the sand down firmly or tamp it down with the shovel-handle; then strike it off level with the top of the frame. Then place the pattern upon the leveled sand and drive the core-print down into the sand with the fist until the bottom end of the pattern is even with the leveled sand, being sure to have the pattern standing vertically. That is the first step of the molding process and is illustrated in cross-section by Fig. 2.

Then another frame is placed around the upright pattern and filled with sand, which is also rammed firmly with the shovel-handle or other convenient tool. This sand, as well as the following layers, should be run through a large-mesh sieve. A third and fourth frame are rammed in in the same manner until a bushing-mold of the desired height is made. Do not ram too hard and do not have the sand too wet. When the last frame is filled and leveled, drip a small quantity of water around the pattern to prevent the sand from crumbling. Then rap the pattern sidewise in all directions and pull it slowly out of the mold, using a screw if necessary. Rap the pattern a little as it is drawn out. The mold is then ready for the core.

The Core Is Set

The core, which should now be baked and cooled enough to handle, is cut the proper length. This length is estimated by measuring the pattern and adding the length of the core-print plus an inch or so for securing the top of the core in the mold. The lower end of the core should be coned a little to make it slip into the core-print mold easily and snugly. The coned end of the core is then lowered into the mold cavity until it will center itself. It is pressed down firmly to be sure no metal gets beneath it to enter the vent and choke up the gas exit. Figure 4 shows a mold with the frames removed and the side shaved off to permit a view of the core in place.

Figure 5 shows how the top of the core is secured in the mold to prevent it from shifting sidewise, also to keep it from floating when the molten metal is poured around it. This is accomplished by placing a flat bar on top of the core and weighting it down upon a couple of wedges. This flat bar should not seal the upper end of the hole, nor should it be so wide as to prevent pouring the molten metal into the mold.

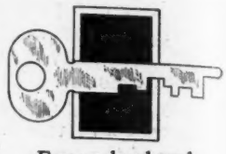
Pouring the Mold

The molten metal should be poured gently into the mold cavity around the core, gently at first to prevent splashing and faster as the cavity fills, being careful not to splash any over the top end of the vent-hole. The mold should be filled an inch or so more than is really needed in order to take care of the shrinkage.

After pouring, the mold is allowed to stand long enough for the molten metal to congeal, then the frames are removed one at a time and the burned molding-sand is carefully torn apart. The bushing is then removed from the mold and the sand is remoistened ready for another mold. It may be used over and over again as long as it lasts. But it is of little avail to try to save the core-sand out of the bearing-stock casting.

Use a Template for Making Keys and Avoid Expense

SOME time ago it became necessary for me to make a considerable number of flat keys all fitting the same lock. The number was not great enough to warrant making a blanking die. To expedite the work I used a method of my own.



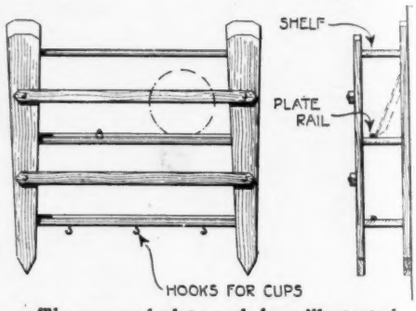
From a hardened steel pattern a number of keys can be made

Taking a piece of flat tool steel of the same thickness as that of the keys, I carefully filed the pattern until it worked the lock smoothly. Then I hardened the steel pattern and drew its temper just enough to prevent it from breaking under the strain. The blanks were then taken one at the time and filed to correspond with the outline of the template. After they were finished, they showed scarcely any variation and worked perfectly. The template would have lasted long enough to make several hundred more keys.—A. DANE.

An Ornamental Rack for Cups and Plates

YOU may make a neat plate-rack by following the description given below. The four corner posts are similar in shape and size. They are ⅞ in. thick, 18 in. long, 3½ in. wide at top, and 2¼ in. wide at bottom. Make them out of yellow pine, and smooth with fine sandpaper.

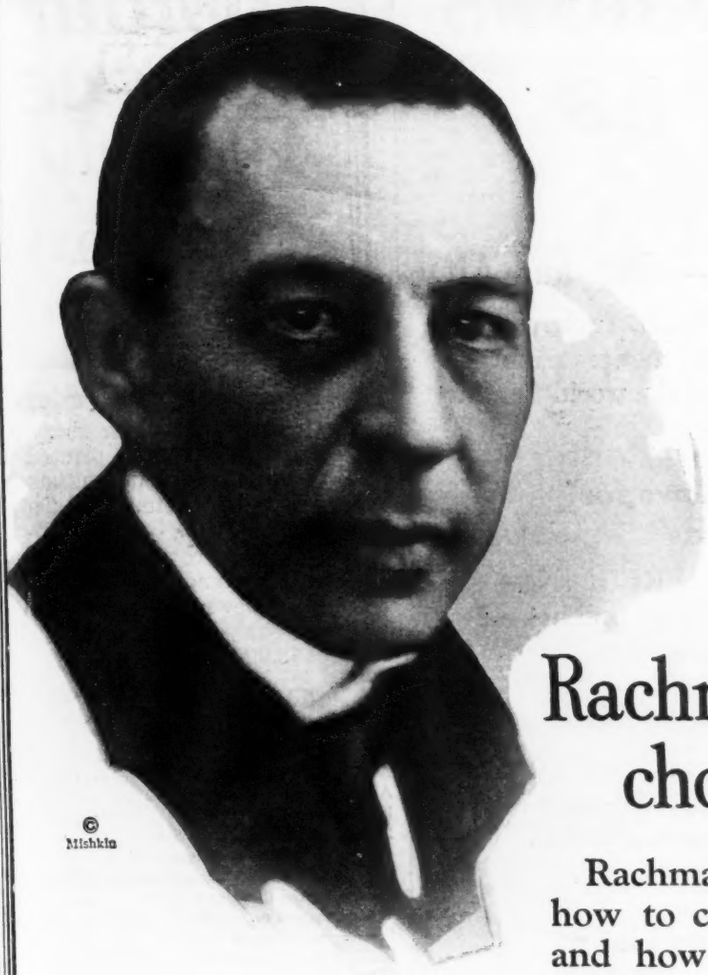
The shelves are nicely squared pieces of yellow pine 26 in. long and ⅞ in. thick. The highest is 4 in. wide, the middle one 3 in. wide, and the lowest 2 in. wide. The inside corners of the lowest post are notched to admit the uprights. The fastening is done with finishing nails and screws.



The cup-and-plate rack here illustrated will provide a place for your china

Grooves are gouged out along the length of the second and lowest shelves to admit the edges of the standing plates. Two rails, 23½ in. long, 1¼ in. wide, and ¼ in. thick, are screwed to the face of the outer posts to keep the plates from falling out. Brass hooks, for hanging cups, are screwed to the low shelf.

The finished article is held to the wall by round-headed screws.



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